RF/ER-96-0014.UN

POND OPERATIONS PLAN: Revision 2

ROCKY MOUNTAIN REMEDIATION SERVICES, L.L.C.

September, 1996

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Effective Date: 10/1/96

I101-A-000257

ADMIN RECORD

REVIEWED FOR CLASSIFICATION/UCNI
BY: J. J. BOGOTT UNU
DATE: 9/25/96

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PADC-96-00358

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1. INTRODUCTION

1.1 PURPOSE OF THE POND OPERATIONS PLAN

The purpose of this document, the Pond Operations Plan (POP), is to describe the Department of Energy, Rocky Flats Field Office (DOE, RFFO) transition plan for modifying operations and management of the onsite surface water detention ponds. The modified operation phases will result in ecological benefits, increased stormwater detention capacity, dam safety enhancements, and more efficient use of Rocky Flats Environmental Technology Site (Site) funds while maintaining water quality.

1.2 GENERAL DESCRIPTION OF THIS DOCUMENT

1.2.1 Format

This POP was written to be a concise description of the transition plan for transitioning Site detention pond operations from batch release mode to controlled detention mode. Much of the technical detail and justification for the proposed new operating modes are explained separately in the POP Technical Appendix (TA)(see Section 1.2.2). References to specific sections of the TA are made throughout this document to assist the reader in reviewing the topic further if so desired.

1.2.2 POP Technical Appendix (TA)

The TA provides supplemental detail and a technical basis for the POP. Topics of the TA include: Site hydrology; spill response programs; contaminated runoff source areas and remediation options; an analysis of the capacity of the ponds to remove radionuclides through settling; operating guidelines for the proposed operating modes based on the analyses; and a description of pond monitoring necessary for each operating phase.

1.3 KEY CONCEPTS

1.3.1 Existing Detention Pond Network

Twelve constructed detention ponds collect surface water runoff from the Site. All runoff from the Site Industrial Area (IA) is captured in the ponds prior to being released offsite in a controlled manner. The ponds, shown in Figure 1-1, are grouped together in series based on the drainage in which they are located:

- A-Series: 4 ponds (Ponds A-1, A-2, A-3, and A-4) in North Walnut Creek,
- B-Series: 5 ponds (Ponds B-1, B-2, B-3, B-4 and B-5) in South Walnut Creek,

- C-Series: 2 ponds (Ponds C-1, C-2) in the Woman Creek drainage,
- D-Series: 2 ponds (Ponds D-1 and D-2) in the Smart Ditch Drainage, and
- Landfill Pond: 1 pond located immediately east of the Site sanitary landfill.

The management of these ponds is addressed in this document. Particular attention is given to Ponds A-4, B-5, and C-2, often referred to as "terminal ponds." They are the ponds furthest downstream in their respective drainages, and the ponds from which water is discharged off the Site.

The ponds serve several purposes for surface water management, including stormwater detention and settling of sediments suspended in the surface water runoff. A detailed description of the current and proposed operating phases for the ponds is contained in Sections 4 and 5. In addition to the 12 ponds mentioned above, several other ponds exist within the confines of the Site boundary. These ponds are not addressed in this document because they are not used to manage surface water runoff[1].

1.3.2 Current Method for Offsite Water Discharges: Pumped Batch Release Mode

Offsite discharges of water from the terminal ponds are currently conducted, during routine operations, in a "batch release" mode. This means that flows in and out of an individual pond are temporarily terminated, thereby isolating the pond's water from the rest of the pond network. A sample of the isolated water is then collected and, if sample results indicate water quality standards and goals are met, the "batch" of water is pumped out of the pond to a stream that flows off the Site.

1.3.3 Proposed Future Method for Offsite Water Discharges: Controlled Detention

The proposed method for discharging water offsite is to operate the terminal ponds in a "controlled detention mode." An offsite discharge of water using controlled detention, as defined in this document, is a configuration with water flowing into a pond at the same time that water is flowing out of that pond and off the Site. The inflow and outflow rates are controlled to achieve an established efficiency for removing specific contaminants from the water. Because controlled detention may be operated continuously for several months, it is advantageous to utilize gravity, versus pumps, to remove water from the ponds. Note that the Site's goal is to implement controlled detention in the future; based on future Site conditions and stakeholder approval. Transition to controlled detention operations will be achieved incrementally using a phased approach.

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[1] These other ponds include the Lindsey Ranch Pond in the Rock Creek drainage and the D-Series Ponds in the Smart Ditch drainage south of Woman Creek.

1.3.4 Site Engineering Improvements and Option B Improvements

The change in operating modes proposed by this document takes into consideration (1) planned and completed engineering improvements for the detention pond dams at the Site, (2) Option B engineering improvements completed and planned downstream from the Site, and (3) modifications to the Site Wastewater Treatment Plant (WWTP).

Improvements planned for detention pond dams at the Site include upgrading the outlet works and/or installing standpipes at dams where controlled detention will be implemented (See Section 3.2).

Option B improvements, funded by DOE, were conceived to protect downstream water supplies from potential contamination by runoff from the Site and to provide an alternative water supply to specific downstream water users. Option B includes the completed Standley Lake Protection Project (known as the Woman Creek Reservoir), and the Carter Lake Pipeline, which will supply the new City of Broomfield water treatment plant with Windy Gap water. This new water treatment plant replaces the existing water treatment plant which is supplied by raw water from Great Western Reservoir located downstream of the Site.

Influent and effluent equalization basins are currently being constructed for the WWTP. These basins will allow for attenuation of WWTP flows as well as provide spill containment capacity. Additionally, a pipeline from the WWTP to Pond A-3 is planned which would allow for preferential routing of WWTP effluent to either Pond B-3 or A-3.

1.4 POP ASSUMPTIONS

Assumptions made in writing this document include:

- The ponds will continue to be utilized primarily as storm water management facilities.
- A primary goal of the plan is to ultimately discontinue pumping and use the dam outlet works in a controlled detention mode.
- Storm water is the sole source of chronic actinide load to the Site surface water system.
- This document will provide a technical basis for the operations protocols (provided in the TA).
- This document will demonstrate initiative toward contaminant source control (provided in the TA).

- Upstream and downstream engineering improvements, both completed and anticipated (including Option B projects), are incorporated into this plan.
- The ponds will also serve as emergency containment in the event of large storm events or acute contaminant releases.
- The proposed alternative management of Interceptor Trench System water is considered by this plan.
- Other functions will be accommodated, to the extent practicable, including maintenance of habitat both on-Site and downstream.
- The POP is written based on the Proposed Basic Standard of 0.15 pCi/L for plutonium (Pu) and americium (Am). It is recognized that the standard remains to be changed pending CWQCC approval.
- Transition to a controlled detention mode in the ponds is critical to successful decommissioning of the Site through the Accelerated Site Action Plan (ASAP).

1.5 BENEFITS OF PROPOSED NEW OPERATING MODE

The proposed new modes for operating the Site detention ponds will maintain high water quality while significantly reducing operating costs. Most important, the new modes will be equally protective of human health and the environment than the existing "batch release" operational mode. The proposed operations are also consistent with the vision of the Site.

The POP was developed to achieve the following benefits:

- Improved predictability in pond operations management; ultimately change the approach for managing surface water runoff at the Site by replacing the resource-intensive "batch release mode" with a "controlled detention mode";
- Improve stormwater management through increased attenuation capacity;
- Improve dam safety by lowering average pool levels in the ponds;
- Control pollutants from being released offsite and maintain water quality; non-degradation of water quality using a management strategy focused on compliance with stream standards at RFCA Points of Compliance

- Enhance aquatic resources and habitat downstream from the Site by allowing a constant offsite discharge to occur, versus the sporadic release of water that results from "batch release" operations;

- Refine operations to reduce analytical requirements;

- Identify options for removing potential sources of radionuclides and hazardous materials,

- Increase spill containment capacity; and;

- Optimize use of Site funding for risk reduction by decreasing pond operations costs.

- Diminished concern of stakeholders with integration of pond operations, Option B improvements, and improved monitoring consistent with RFCA requirements and the IMP.

2. BACKGROUND

2.1 EXISTING SURFACE WATER FEATURES

2.1.1 Drainages and Diversion Ditches

Surface water flows from the Site via five ephemeral streams which pass through or are adjacent to the Site: Three of these streams, North Walnut Creek, South Walnut Creek, and Woman Creek, contain detention ponds that are the subject of this document and are described below[2]:

- North and South Walnut Creek join to form Walnut Creek, which naturally would flow into Great Western Reservoir. However, water now is rerouted through the Broomfield Diversion Ditch around the reservoir and into Big Dry Creek, which flows to the South Platte River.

- Woman Creek flows eastward into the Woman Creek Reservoir.

Two man-made diversion channels, the West and South Interceptor Ditches, are used to divert runoff at the Site. The West Interceptor Ditch diverts runoff from the North Walnut Creek headwaters north of the IA to Walnut Creek west of Indiana Street. The South Interceptor Ditch diverts runoff from the southern part of the IA away from Woman Creek and into Pond C-2.

These drainages and diversion ditches are shown in Figure 1-1. Hydrologic characteristics of the drainages are described in the TA (TA Reference: Section 2.1).

2.1.2 Detention Ponds

A description of the detention pond network was provided in the Key Concepts section of the Introduction (Section 1.3.1 and Figure 1-1). To reiterate, the detention pond network at the Site consists of 12 constructed ponds grouped together in series (A-, B-, and C-Series plus the Landfill Pond) based on the drainage in which they are located. The terminal ponds, Ponds A-4, B-5, and C-2, are farthest downstream in their respective drainages and the ponds from which water is discharged off the Site.

The ponds serve three main purposes for surface water management: (1) storm water detention and settling of sediments, (2) holding water for sampling and, as necessary, treatment prior release, and (3) emergency spill control in those instances where a spill cannot be adequately managed without use of the ponds.

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[2] The other two drainages, Rock Creek and Coal Creek, do not contain detention ponds of interest to this document.

2.1.3 Dams

The dam of greatest concern at the Site, at Pond C-2, is rated as Class II by the State[3]. Now that Woman Creek Reservoir is in place downstream from Pond C-2, the State in coordination with the Site will determine whether the Pond C-2 dam should be downgraded to a Class III dam. Dams at Ponds A-4, B-5 and the Landfill are Class III, and the remaining Site dams are all Class IV. All of the dams are visually inspected weekly by Site personnel during routine operations. Seven of the twelve dams, including all of the Class II and III dams, have piezometers that are monitored weekly. Piezometers at Ponds A-3, A-4, B-5, and C-2 are monitored every 8 hours by the RMRS Environmental Telemetry System. In addition, selected dams are subject to a more formal inspection once per year by the Federal Energy Regulatory Commission (FERC).

2.2 HISTORY OF SITE POND OPERATIONS

Between the mid-1950s and 1962, the pond network at the RFETS consisted of Pond A (now known as Pond A-1), Ponds B-2, B-3, B-4, and Pond C (now known as Pond C-1) (Dow, 1972; Dow, 1973a). Pond B-1 was added in 1962. These ponds were operated in series with the flow from one pond entering the next pond downstream until the final pond was reached and the water was discharged off plant site. In June 1973, construction was completed on the three drainages to provide 1) additional detention capacity, and 2) the capability of bypassing flows around particular ponds (Dow, 1973b; Dow, 1971.) A portion of the additional detention capacity created at that time was related to the construction of new ponds, while the remainder of the increased capacity was provided by raising the level of the existing dams (Dow, 1971.)

By mid 1974, Ponds A-1, A-2, A-3, B-1, B-2, B-3, B-4, and C-1 were in operation, with Ponds A-1, A-2, B-1, B-2, and C-1 all equipped to handle spills (Dow, 1974.) The ponds were operated in series until December 21, 1973, at which time Ponds A-2 and B-2 were connected by pipeline, allowing for water transfer between the two ponds, and isolated from the rest of the flow system to allow for management of untreated decontamination laundry wastewater (USAEC, 1974.) Construction of the current terminal ponds, A-4, B-5, and C-2, began in 1979 and was completed in 1980 along with surface water interceptor canals to improve surface water management (Rockwell, 1980; Rockwell, 1981.) After the construction of Pond C-2 and the South Interceptor Ditch, Pond C-2 became the C-Series pond available for spill control.

[3] State dam classifications range from Class 1 (highest concern; loss of human life if dam fails) to Class IV (lowest concern; no loss of human life expected if dam fails).

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2.3 REGULATION OF POND DISCHARGES

Pond discharges are currently governed by the existing Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) permit as modified by the NPDES Federal Facilities Compliance Agreement (FFCA) in March, 1991. The NPDES FFCA continues to control pond discharges under the CWA, which places additional requirements on the Site, including upgrades to treatment facilities, studies of tanks, drains, sludge drying beds, and increased monitoring and reporting requirements. The ponds are utilized as an important Best Management Practice (BMP) as documented in the Spill Control Countermeasures/Best Management Practices (SPCC/BMP) Plan; also required by the NPDES permit (EG&G, 1992).

The newly signed Rocky Flats Cleanup Agreement (RFCA) requires compliance monitoring at the terminal pond outfalls. Under RFCA, terminal pond discharge samples will be analyzed for selected analytes of interest, and the 30-day moving average of the analytical values will be compared against stream standards for Segment 4 of Big Dry Creek to determine compliance. Non-attainment of the stream standards at these outfalls can result in receipt of regulatory penalties for the Site.

3. SITE ENGINEERING IMPROVEMENTS

Several options exist for capital improvements to the North and South Walnut Creek drainages which could make future pond operations more efficient. Pond operations efficiency equates to the simplicity of operations; (i.e. fewer adjustments of outlet valves and fewer batch cycle operations).

3.1 DAM UPSTREAM GATE VALVE UPGRADES

The outlet upgrade projects address concerns by the Colorado State Engineers Office, the Federal Energy Regulatory Commission, and the Army Corps of Engineers that the concrete pipes running under the dams, as currently configured, are under continual pressure when water is held in the ponds. Concrete pipes are normally used in non-pressurized applications, therefore the need was established for valves on Dams A-4, B-5, and C-2. The valves, located on the end 'upstream' of the outlet works, will relive pressure on the pipes when the valves are closed

Installation of the upstream gate valve at Pond A-4 was completed on September 30, 1996. Completion of the gate valve upgrades at Ponds B-5 and C-2 is dependent on future available funding.

Stand-pipes, or sediment-control structures, were added to the scope of the upstream gate valve project to allow continuous flow, or controlled detention, through the pond outlet works. The stand pipe design will control the water elevation in the pond, the rate of discharge, and thereby draw effluent water from the pond surface. The control on the elevation and rate of discharge can be achieved through a variety of designs, for example drilling holes in the side of the stand pipe allows a fixed rate of water flow into the stand pipe and out the outlet works. Another example could be to use a valve or a combination of valves located at the base or on top of the stand pipe to control the rate of flow.

The Pond A-4 sediment-control structure consists of inlet boxes located on the dam face at approximately the 10 percent and 20 percent full elevations. The inlet boxes are connected to the main gate valve that can be throttled to allow controlled pond drawdown. At its fully open position, the main gate valve will allow up to 30 cfs to flow through the outlet works.

The schedule for installation of the dam stand pipes is concurrent with the gate valve upgrades. The Pond A-4 stand pipe installation, as previously stated, was completed in September 1996. Scheduling of stand pipe installations at Ponds B-5 and C-2 is contingent on funding.

3.2 WWTP PIPELINE TO POND A-3

A diversion pipeline that will allow WWTP effluent to be routed to Pond A-3 is planned as an enhancement to pond operations. The current pipeline to Pond B-3 will remain operational. Analysis of 1992-1996 pond inflow and WWTP effluent discharge data for Walnut Creek show that the WWTP effluent represents 46% of upstream surface water contributions to the A- and B-Series ponds. Additionally, N. Walnut and S. Walnut Creeks represent 32% and 22% of inflows, respectively. Therefore, by being able to route WWTP effluent to either A-3 or B-3, optimum stormwater attenuation capacities can be maintained for each drainage. Selective routing of WWTP effluent will also make possible B-5 batch discharges, using the upgraded outlet works, which can be completely isolated from WWTP effluent.

3.3 WWTP INFLUENT/EFFLUENT STORAGE TANKS

Under the 1991 National Pollutant Discharge Elimination System (NPDES) Federal Facility Compliance Agreement (FFCA), the Site agreed to install influent and effluent storage tanks at the wastewater treatment plant (WWTP). These projects were included in the third phase of the NPDES FFCA compliance schedule submitted for approval to the Environmental Protection Agency (EPA). Subsequently, EPA agreed to a delay in Phase III projects until a final scope could be determined, and, in 1994, agreed to the inclusion of the storage tanks as a milestone in the Industrial Area Interim Measure/Interim Remedial Action Plan. Construction of these tanks is scheduled for completion in 1998, which will meet the deadline imposed by EPA.

When complete, the storage tanks will provide protection of the wastewater treatment plant's unit processes from off-normal influent, and, if the plant is upset, the effluent storage tanks will protect receiving waters. The influent storage capacity was designed to serve a dual purpose; these tanks will also serve as flow equalization. Although the facility has existing flow equalization basins in Building 990, the capacity is just 60,000 gallons, only a portion of one day's flow into the WWTP. The newly constructed influent storage tanks will provide approximately five times the existing capacity for equalization. Final operational controls and protocols have not been developed, so the actual amount used for equalization has not been determined. Likewise, a final operations plan for the effluent tanks has not been developed. The effluent tanks are designed to serve as emergency facilities, with a total capacity of 500,000 gallons, and will not be part of normal routine plant operation. However, the effluent storage tanks are a part of the Site's fire protection system, and will be required to maintain a minimum of 100,000 gallons of water at all times for fire fighting. There is currently no other source of water for fire protection available in the vicinity of the WWTP.

In the most recent draft of the renewal NPDES permit, EPA required an operational plan for the influent and effluent storage tanks. The draft permit requires a final plan within 18 months of the completion of construction. It is anticipated that the operational plan for the tanks will serve for the remainder of active site remediation, and will accommodate completion of most decommissioning activities. No further upgrades to the WWTP facility are planned at this time nor are any contemplated. The WWTP is expected to continue to provide service to the Site throughout the remediation period, and through to the end of final closure actions.

4. POND OPERATIONS PRIOR TO OCTOBER 1996

4.1 OPERATIONS SUMMARY

A plan that describes operations protocol for all of the Site's 12 detention ponds was prepared and offered to stakeholders for review in mid-1994. That plan, included as Appendix A, will remain largely in effect through October 1996. Some activities have been curtailed, such as the use of spray evaporation. Pond operations before October 1996 are summarized in this section.

4.1.1 A- and B-Series Ponds

Prior to October 1996, all of the water flowing down North and South Walnut Creeks (the majority of the flow that comes off the IA) was ultimately collected in Pond A-4 (disregarding the large percentage of runoff that infiltrates into the ground and never makes it to the ponds). North Walnut Creek water flowed naturally to Pond A-4 via Pond A-3 which periodically was batch discharged to Pond A-4. South Walnut Creek water flowed to Pond B-5, from where water was pumped over to Pond A-4.

After Pond A-4 was filled to roughly 50% of capacity, flows into Pond A-4 (from Ponds A-3 and B-5) were discontinued, thereby isolating the A-4 water from the rest of the pond network. A sample of the A-4 water was collected and, if sample results indicated water quality standards and goals were met, the "batch" of water was pumped out of Pond A-4 to North Walnut Creek and off the Site. Batch releases from Pond A-4 occurred from 6 to 12 times per year, depending on the amount of precipitation received at the Site, and involved approximately 100 to 200 million gallons of water annually.

Pre-October 1996 operations for all of the A- and B-Series ponds are summarized in Table 4-1.

4.1.2 C-Series Ponds

Water flowing off the IA that was not eventually routed to Pond A-4 flowed to Pond C-2 (disregarding the large percentage of runoff that infiltrates into the ground and never makes it to the ponds). Pond C-2 was batch released, using pumps, to the Broomfield Diversion Ditch from 0 to 2 times per year, involving up to 25 million gallons annually.

Pre-October 1996 operations for both of the C-Series ponds are summarized in Table 4-1.

4.1.3 Landfill Pond

The Landfill Pond was batch transferred only after filling to a level that caused dam safety concerns. These transfers, typically either to Pond A-1 or Pond A-2, occurred 1 to 3 times per year and involved up

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to 7 million gallons of water annually. Alternatively, the Landfill Pond was transferred to Pond A-3 via the A-1 Bypass.

Operations for all of the Site detention ponds, as operated prior to October 1996, are summarized in Table 4-1. Details of these operations are contained in Appendix A.

Table 4-1 Summary of Pond Operations Prior to October 1996

Pond	Primarily Use	Inflow From	Outflow To	Method Used to Release Water/ Additional Comments
A-1	A-Series Spill Control	Normally Off-line; Can receive flow from N. Walnut Cr. or Landfill Pond.	A-2	Pumped Transfer to Pond A-2
A-2	A-Series Spill Control	Normally Off-line; Can receive flow from N. Walnut Cr. or Landfill Pond.	A-3	Pumped Transfer to Pond A-3
A-3	Flow attenuation; isolate flow from Pond A-4	N. Walnut Cr.; runoff from N. Industrial Area.	A-4	Outlet works release to Pond A-4
A-4	Flow attenuation; Batch storage prior to offsite discharge.	B-5 and A-3	N. Walnut Cr. to Broomfield Diversion Ditch	Pumped Discharge to N. Walnut Creek or Discharged Through New Outlet Works With Water-Quality Controls
B-1	B-Series Spill Control	Normally Off-line; Can receive flow from S. Walnut Cr.	Downstream B-Series Ponds	Pumped Transfer to Downstream B-Series Ponds
B-2	B-Series Spill Control	Normally Off-line; Can receive flow from S. Walnut Cr.	Downstream B-Series Ponds	Pumped Transfer to Pond A-2
B-3	WWTP effluent storage and attenuation	WWTP	Pond B-4	Outlet works release to Pond B-4
B-4	Flow attenuation	S. Walnut Creek	Pond B-5	Outlet works release to Pond B-5

Table 4-1 Summary of Pond Operations Prior to October 1996 (continued)

Pond	Primarily Use	Inflow From	Outflow To	Method Used to Release Water/ Additional Comments
B-5	Flow attenuation; storage prior to transfer to Pond A-4.	Pond B-4 and potentially other upstream B-Series Ponds	Pond A-4	Pumped Discharge to Pond A-4
C-1	Flow attenuation, water sampling	Woman Creek	Woman Creek	Outlet works release to Woman Creek
C-2	Flow attenuation; Batch storage prior to offsite discharge.	South Interceptor Ditch	Broomfield Diversion Ditch	Pumped Transfer to Broomfield Diversion Ditch.
Landfill	Batch storage prior to onsite transfer	Groundwater / spring water from sanitary landfill	Pond A-1, Pond A-2, or Pond A-3	Pumped Transfer to Pond A-1, Pond A-2, or A-1 Bypass to Pond A-3, in that order of preference.

4.2 DAM SAFETY

Dam safety practices at the Site prior to October 1996 will continue to remain in effect for the foreseeable future. The Site detention pond dams are all earthen structures that are carefully monitored to ensure dam safety. Dams are inspected weekly during routine operations, and more frequently if conditions warrant. Piezometer measurements are also collected weekly at Ponds A-3, A-4, B-1, B-3, B-5, C-2, and the Landfill Pond, and the data are evaluated for indications of dam structural problems.

In addition to the routine inspections, an annual inspection is performed on select dams by inspectors from the Federal Energy Regulatory Commission (FERC). Concerns regarding dam safety are also conveyed to the State Engineer's office.

Pond operations are described as either "normal" or "emergency" based on a combination of retained pond volume, weather conditions, water quality, and dam safety criteria that includes piezometer data. Normal operations are defined as those operations conducted on a routine and relatively continuous basis. Emergency operations are defined as specific actions or operations taken in response to abnormal, non-routine occurrences. The transition from normal operations to emergency operations, with respect to dam safety, occurs in response to specified Action Levels as outlined in the *Emergency Response Plan for Failure of Dams A-4, B-5, or C-2* (1-A25-5500-06.08, Rev. 0) procedure (EG&G 1995). This plan is contained in Appendix B and defines seven Action Levels (0 through 6), of which Action Levels 4, 5, and 6 constitute emergency conditions:

- Action Level 4 is triggered by conditions that indicate the structural integrity of the dam is threatened. These conditions include significant cracks, sloughing, piezometers exceeding limits, or a pool level equal to the spillway level. Inspections are performed every 8 hours.

- Action Level 5 is triggered by a pond condition more serious than Action Level 4 and may include seepage or unplanned release occurring through the spillway. Inspections are performed every 2 hours.

- Action Level 6 is triggered by actual failure of the dam or conditions where failure is imminent with uncontrolled release of water, sediments, and dam materials to the downstream watershed. Continuous monitoring of the dam is required with this Action Level.

All emergency operations are subject to modification consistent with the *Emergency Response Plan for Failure of Dams A-4, B-5, or C-2* which is part of the Site Emergency Preparedness Implementation Plan (Appendix B).

4.3 SPILL CONTROL

4.3.1 Emergency Response Organizations

Emergency response planning efforts at the Site, including spill response, are coordinated by the Emergency Preparedness group. First response to spills is performed by Emergency Services, which includes the Site Fire Department and Hazardous Materials (HAZMAT) Team. Both the Emergency Preparedness and Emergency Services groups are part of DynCorp of Colorado. Additional on-site organizations, including RMRS Sitewide Surface Water Group (SSW), provide support to the first response teams, as needed, depending on the nature of the spill.

The interaction between various Site organizations, DOE, State and Federal regulatory agencies, and neighboring communities for conducting spill notification and response activities is illustrated in Figure 4-1 and Figure 4-2. A brief summary of spill response personnel, equipment and countermeasures is contained in this section of the POP. More detailed descriptions for these topics are contained in the TA (TA Reference: Section 3).

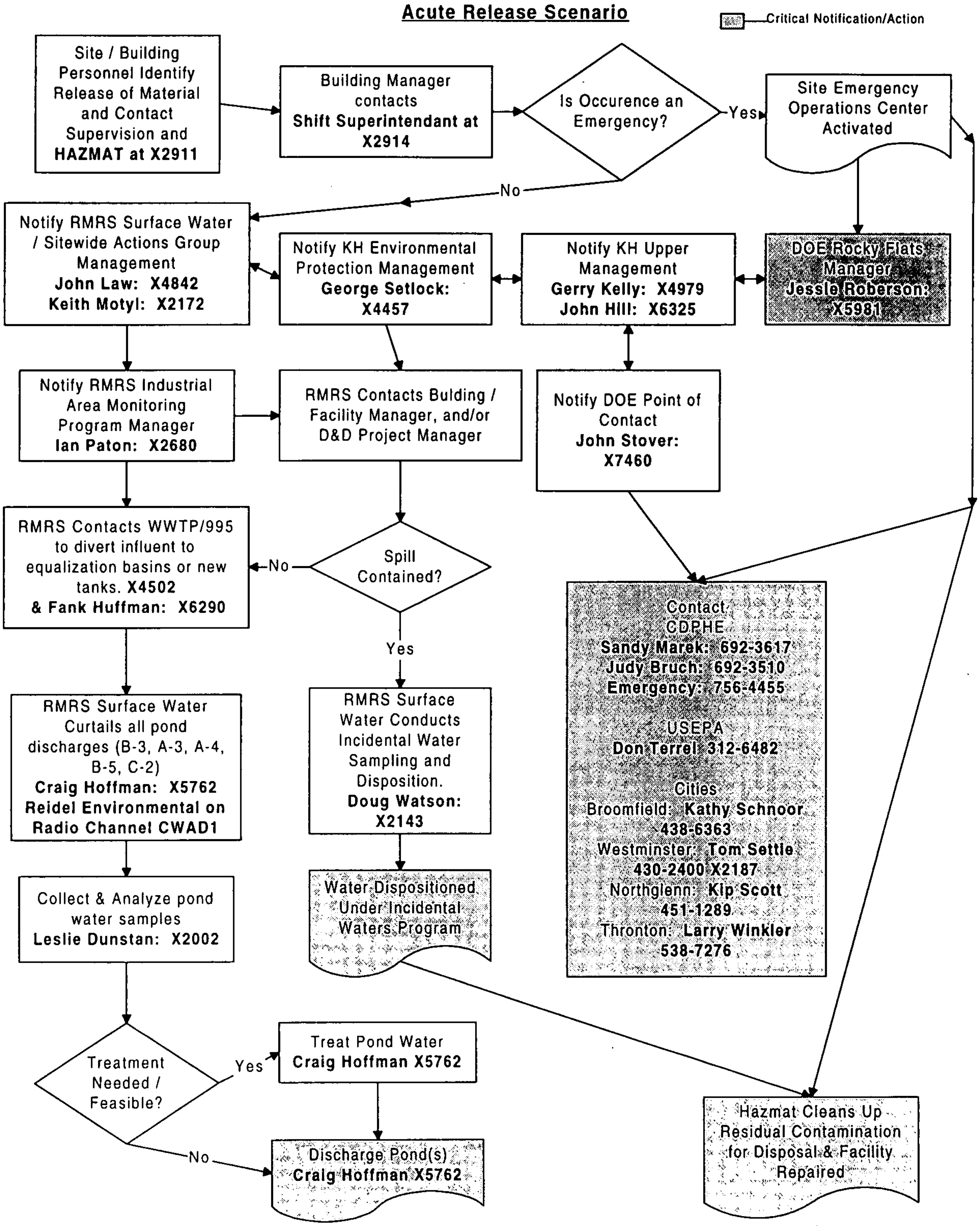

Figure 4-1. Communication / Notification Diagram for Spill Control and Surface Water Protection at Rocky Flats: Acute Release Scenario

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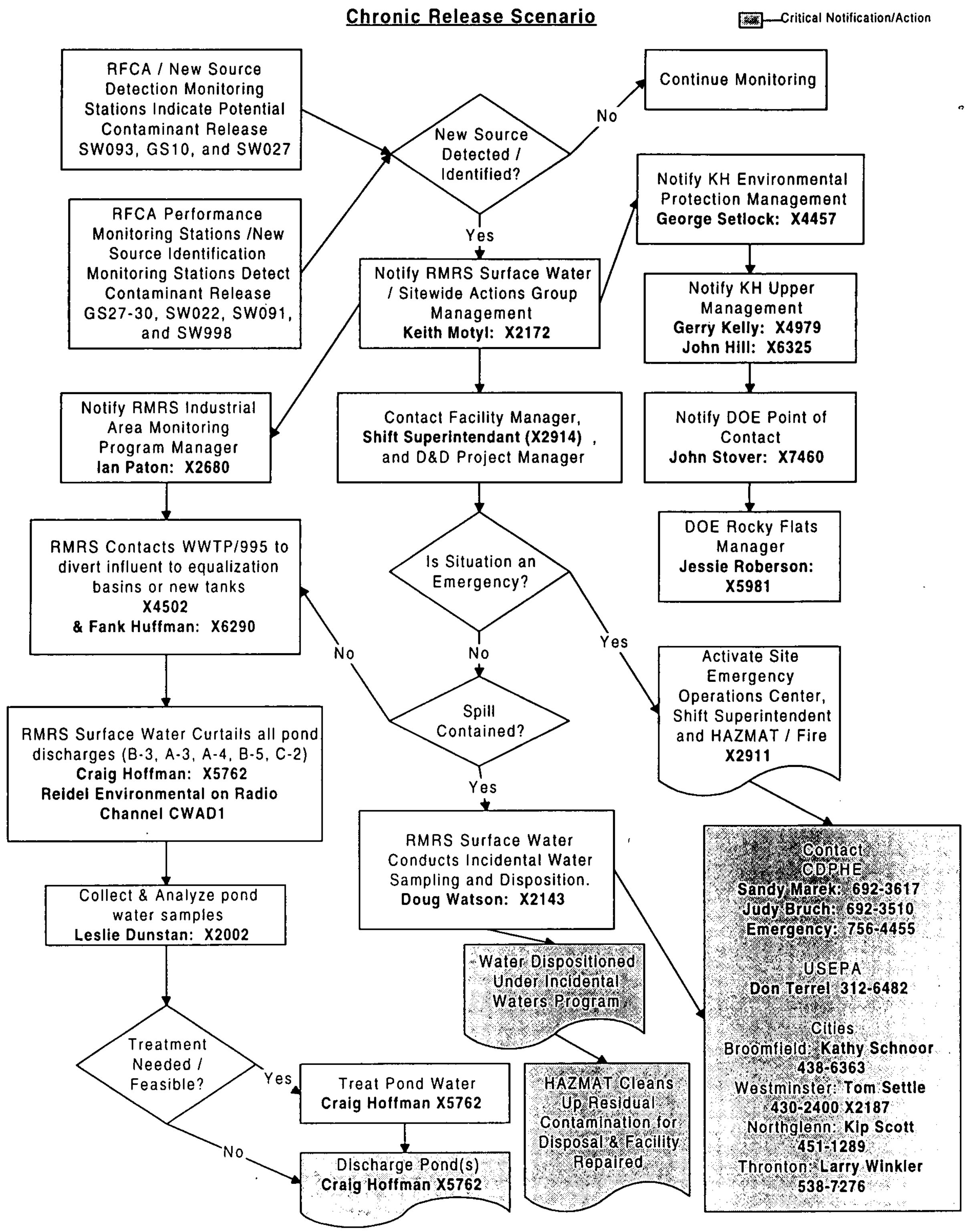

Figure 4-2. Communication / Notification Diagram for Spill Control and Surface Water Protection at Rocky Flats: Chronic Release Scenario

4.3.2 Spill First Responder Personnel

- Shift Superintendent - First contact beyond immediate supervisor for reporting a spill. A Shift Superintendent is on site 24 hours per day, 7 days per week.

- Hazardous Materials Team (HAZMAT Team) - Fire Department employees fully trained and certified in hazardous materials response. Average response time in 1995 was 2 minutes and 30 seconds (Parker, 1995).

4.3.3 Spill Response Support Organizations

Concurrent with the HAZMAT Team spill containment and cleanup activities, other organizations become involved in a spill cleanup, depending on the nature of the release. A partial list of these supporting groups includes Waste Regulatory Programs, Health Physics, Industrial Hygiene, Utilities, Heavy Equipment and Trucking, Chemical Operations, Security, and Waste Management. If the release could potentially impact surface water, then the SSW provides support.

4.3.4 Spill Response Equipment

- HAZMAT Team - HAZMAT 1, a fully equipped hazardous materials response truck, and Mobile 1, a hazardous materials response supply trailer, are kept onsite and inspected weekly by emergency response personnel.

- OU2 Equipment - Spill response supplies and equipment are stored at the OU2 trailer located near the east entrance to the IA.

- Other Equipment - Smaller spill kits are maintained within buildings throughout the IA. Spill containment supplies are also maintained near Pond A-4 by RMRS.

4.3.5 Additional Spill Containment / Prevention Measures

- Detention Ponds - In the event the HAZMAT Team effort to contain a spill is unsuccessful, valves and gates can be configured to utilize specific detention ponds for spill containment. A procedure, *Containment of Spills Within the Rocky Flats Drainages* (1-C90-APR-SW.03), outlines the necessary steps to take in such circumstances.

- WWTP Influent / Effluent Storage Tanks - Currently under construction, these tanks will provide a total of 500,000 gallons of storage to divert suspect influent away from the WWTP, or to hold suspect WWTP effluent before it is discharged to the ponds. Construction of these tanks is scheduled for completion in 1998. Further detail on this project is contained in Section 1.3.4 of this POP.

- Incidental Waters program - Waters that accumulate in excavation pits, secondary containment berms, valve vaults, or utility pits are sampled and analyzed before being disposed of. If sample results indicate the water does not meet release criteria, then the water is tanked and transported to a treatment facility. Further detail on this project, guided by procedure Control and Disposition of Incidental Waters (1-C92-EPR-SW.01) (EG&G, 1993a) is contained in the TA (TA Reference: Section 3.4.7).

- Drain Identification Study (DIS) - Drains at the Site were inspected to identify possible pathways to the Waste Water Treatment Plant to avoid inadvertent discharges of hazardous materials into sanitary drain systems. Inappropriate connections to the sanitary sewer were marked and blocked. The DIS was an activity required by the NPDES FFCA.

- Tank Management Plan (TMP) - The TMP is a comprehensive aboveground storage tank inventory, integrity assessment and data tracking program. The inventory of all tanks at the Site was completed and 88% of the initial integrity testing was completed at the end of fiscal year 1995 after which routine integrity assessments were transferred to building owners for completion of FFCA requirements.

4.3.6 Spill Response Training Exercises

Exercises are a key element of the DOE emergency management program and are conducted at the Site to develop, maintain, test, and evaluate response capabilities of personnel, facilities, equipment, procedures, and training under simulated conditions as dictated by DOE Orders 5500.1B and 5500.3A. Two types of drills are conducted at least annually that relate specifically to spill response:

- The HAZMAT Monitoring Drill involves monitoring, collecting, and analyzing sample media (water, vegetation, soil, or air) and takes into consideration requirements for decontamination, communications, and handling of worker exposure records.

- Second, all buildings on-site that contain HAZMAT are subject to building-specific HAZMAT Drills.

4.4 POND OPERATIONS EMERGENCY COORDINATION

Emergency conditions were addressed in the Senior Executive Committee Dispute Resolution Document signed on April 15, 1994. The DOE, the Environmental Protection Agency (EPA), and the Colorado Department of Public Health and Environment (CDPHE) agreed to certain notification requirements in the event that emergency conditions require activation of the Site's established emergency response procedures (e.g., activation of the Site's Emergency Operations Center). The agreement had the intent of proactively delineating the "alternative water management practices" and reaching agreement on implementation and responses.

4.4.1 Notifications

After the Operations Manager and Shift Superintendent have been notified, the occurrence is categorized per procedure as an Emergency, Unusual Occurrence, or an Off-Normal Occurrence, and approval is given to the Emergency Operations Center Notification Officer (EOCNO) to make appropriate notifications. The EOCNO staff makes on-site and off-site verbal and written notifications as outlined in the Occurrence Notification Process procedure. Waste Regulatory Programs staff provide technical assistance, as required, in determining which regulatory agencies must be notified.

5. POND OPERATIONS TRANSITION PLAN

5.1 TRANSITION PROCESS

In keeping with the programmatic goals, a *four-phased* approach to modifying and improving pond water management practices at the Site will be implemented. Operation of the ponds throughout the transition period is summarized in Table 5-1. Details for each phase are included in Section 8 of the TA. Note that, for all of the ponds, dam safety concerns can override water-quality concerns and force implementation of the *Site Emergency Response Plan for Failure of Dams A-4, B-5, and C-2.*

Changes in operating regimes will be undertaken that lead to implementation of a controlled detention storm water management system (Phase III), and ultimately a flow-through pond system requiring minimal management. Each phase will include the following steps.

- Optimize pond management process for wet and dry seasons,
- Review new operating regime with stakeholders and incorporate inputs,
- Implement on-going and new watershed protection measures,
- Continue to operate the ponds to provide water quality consistent with stream standards, and
- Verify fulfillment of prerequisites and assumptions required by each phase.

The progression from one phase to the next will be dictated by the completion of projects or actions and consultation with stakeholders. These items are described in the sections titled Prerequisites and Assumptions for each phase.

Table 5-1. Summary of Pond Operations Transition Process

	Pre- A-4 Project (Pre-May 1996)	Phase I (October 1996)	Phase II (Date Unknown)	Phase III (Date Unknown)	Phase IV (ASAP)
A-Series					
Ponds A-1, A-2	Normally off-line; maintain for spill control; keep sediment submerged			→	
Pond A-3	Batch dischg. to A-4	→	Batch dischg. to A-4; WWTP effluent routed to A-3 or B-3 for optimized pond water management	Constant controlled detention dischg. to A-4 at specified flow rate (Route WWTP effluent preferentially to B-3)	Final ASAP configuration of ponds
Pond A-4	Pumped batches to NWC *Upgrade A-4 outlet works*	Batch discharged to NWC through outlet works; ITS water piped to A-4 through managed discharge	Batch discharged to NWC through outlet works (piped inflow from ITS to A-4 discontinued; ITS water direct discharged to NWC, if applicable)	Constant controlled detention dischg. to NWC w/ inflow rate equal to outflow rate (If A-3 fills to 80%, stop A-4 outflow, discharge A-3 at 1/day, initiate batch discharge operations for A-4)	Ponds operated in a flow-through state without active management
B-Series					
Ponds B-1, B-2	Normally off-line; maintain for spill control; keep sediment submerged			→	
Pond B-3	Daily batch discharge to B-4 during daylight hours	→	Continuous discharge to B-4	→	
Pond B-4	Continuous flow-through			→	
Pond B-5	Pumped batches to A-4	Pumped batches to A-4 *Install B-5 upstream gate valve and stand pipe*	B-5 batch released through upgraded outlet works (only after Phase I WWTP and ITS changes have been implemented; WWTP effluent routed to A-3 during B-5 discharge cycle; B-5 receives only stormwater during batch cycle)	Constant controlled detention dischg. at inflow rate to SWC (If max. allowable B-Series inflow rate exceeded, then B-5 temporarily switched into batch mode; WWTP effluent routed to A-3 during B-5 batch mode)	
C-Series					
Pond C-1	Continuous flow-through			→	
Pond C-2	Batch and pump discharge to GWR Diversion	Batch and pump discharge to Woman Creek and Woman Creek Reservoir *Upgrade outlet works?*	→ →	Batch and direct discharge (outlet works) to Woman Creek and Woman Creek Reservoir	
Landfill Pond	Batch pump discharged to A-1, A-2, or A-3 when necessary			→	
Other Operations					
ITS Water (if applicable)	N/A	*Install ITS pipeline to A-4*; then, route ITS water to A-4; then, *obtain 100mg/L standard for NO_3^- in NWC*	Piped ITS water routing to A-4 discontinued; ITS water direct discharged to NWC	→	
WWTP Effluent	Discharged to B-5 (via B-3)	Discharged to B-5 (via B-3); *Install WWTP pipeline to A-3*	WWTP effluent routed to A-3 or B-3 for optimized pond water management	→	

(Shaded entries denote operational changes from previous phase; *italicized entries are tasks which are required to move to the next phase*)

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5.2 PHASE I

Specific details on the operational protocol for Phase I is included in Section 8.1 of the POP Technical Appendix.

5.2.1 Prerequisites and Assumptions

- Completion of the A-4 outlet works upgrades.
- In the event that the proposed ITS Management Plan is agreed upon by the concerned parties, a pipeline from the ITS modular storage tanks to below A-3 will be completed during Phase I. ITS water will be diverted to Pond A-4 when pond water is available for assimilation of ITS water. Diversion of this ITS water necessitates continued pump transfer of Pond B-5 water to Pond A-4.

5.2.2 Key Components

Tasks

The following tasks need to be completed during Phase I in order to move on to Phase II of pond operations.

- Install pipeline from WWTP to Pond A-3 (current WWTP outfall to Pond B-3 to remain operational). Completion of this task will allow for selective diversion of WWTP effluent to either B-3 (flow-through to B-5) or A-3. Selective diversion facilitates enhanced detention capacity, the de-watering of B-5 to construct the outlet works upgrades, and subsequent batch and direct discharge of B-5.
- Complete upgrades to B-5 outlet works to allow for direct discharge through outlet works during Phase II.
- Obtain the 100 mg/L standard for NO_3^- in North Walnut Creek (NWC) if the ITS water diversion is ongoing. Attainment of this standard allows for the direct discharge of ITS water to NWC. With the ITS direct discharging to NWC, pump transfer of B-5 water to A-4 will no longer be required to assimilate ITS discharges. Therefore, B-5 can then be batch discharged directly to South Walnut Creek (SWC) using the upgraded outlet works.
- Pond C-2 outlet works may be upgraded during this phase, though this task is not critical for implementation of the next phase (Phase II).

Operations

Operations for B-1 through B-4, A-1, A-2, C-1, and the Landfill Pond remain unchanged for Phases I-II and are summarized in Table 5-1.

- Pond A-3 is batch discharged to A-4.
- Pond A-4 is batch discharged using the upgraded outlet works to North Walnut Creek.
- Continued pump transfer operations from Pond B-5 to A-4.
- Pond C-2 is batch and pump discharged to Woman Creek, which flows to the Woman Creek Reservoir.
- If the Proposed Management for ITS Water is implemented, ITS water will be pipeline discharged to Pond A-4.
- Ongoing monitoring and evaluation of influent contaminants and transport mechanisms, and continued pond water discharge monitoring to assure downstream parties of water quality.
- Continued removal or stabilization of potentially mobile contaminants in watershed areas.
- Schedule of discharges announced to the regulators.

5.3 PHASE II

Specific details on the operational protocol for Phase II is included in Section 8.2 of the POP Technical Appendix.

5.3.1 Prerequisites and Assumptions

- Completion of the B-5 outlet works upgrades.
- In the event that the proposed ITS Management Plan is being implemented, the 100 mg/L NO_3^- standard for NWC will have been obtained and stakeholder agreement on the direct discharge of the ITS to NWC will be achieved.
- The WWTP to Pond A-3 pipeline will be completed and operational.
- New Broomfield Water Treatment Plant is online.

5.3.2 Key Components

Tasks

The following tasks need to be completed during Phase II in order to move on to Phase III of pond operations.

- Pond C-2 outlet works will be upgraded prior to moving to Phase III operations for C-2.

Operations

Operations for B-1 through B-4, A-1, A-2, C-1, and the Landfill Pond remain unchanged for Phases I-II and are shown in Table 5-1.

- Pond A-3 is batch discharged to A-4.
- Pond A-4 is batch discharged to North Walnut Creek using the upgraded outlet works. Pond A-4 is isolated from all inflows during batch discharge cycles (sampling, sample analysis, discharge). Generally, Pond A-4 discharges are alternated with B-5 discharges.
- Pond B-5 is batch discharged to South Walnut Creek using the upgraded outlet works. During batch discharge cycles, B-5 will receive only stormwater runoff; WWTP effluent will be routed to A-3. Generally, Pond B-5 discharges are alternated with A-4 discharges.
- Pond C-2 is batch and pump discharged to Woman Creek, which flows to the Woman Creek Reservoir, pending completion of outlet works upgrades.
- If the proposed management for ITS water is implemented, and the 100 mg/L NO_3^- standard for NWC has been obtained, ITS water will be direct discharged to NWC with stakeholder approval.
- WWTP effluent will be selectively routed to Pond A-3 or B-3.
- Ongoing monitoring and evaluation of influent contaminants and transport mechanisms, and continued pond water discharge monitoring to assure downstream parties of water quality.
- Continued removal or stabilization of potentially mobile contaminants in watershed areas.
- Schedule of discharges announced to the regulators.

5.4 PHASE III

Specific details on the operational protocol for Phase III is included in Section 8.3 of the POP Technical Appendix. The technical basis for controlled detention operations is detailed in Section 7 of the TA.

5.4.1 Prerequisites and Assumptions

- Completion of the C-2 outlet works upgrades.
- Concerned parties agree to use controlled detention operations based on Site conditions and operations at that time.

5.4.2 Key Components

Tasks

Tasks needed to be completed during Phase III in order to move on to Phase IV are undefined at this time. When the final vision for the Site has been determined, then tasks required to transition from Phase III to Phase IV can be identified.

Operations

Operations for B-1 through B-4, A-1, A-2, C-1, and the Landfill Pond remain unchanged for Phases I-II and are shown in Table 5-1.

- Pond A-3 is controlled detention discharged to A-4 at a regulated flow rate based on water quality analysis.
- Pond A-4 is controlled detention discharged to North Walnut Creek using the upgraded outlet works. The A-4 flow-through rate is controlled at A-3 to promote physical processes to maintain water quality goals. The A-Series Ponds would temporarily enter batch operations based on pre-defined criteria related to stormwater inflow rates and pond volumes.
- Pond B-5 is controlled detention discharged to South Walnut Creek using the upgraded outlet works. B-5 would be allowed to flow-through at rates that promote physical processes to maintain water quality goals. Should pre-defined flow rates be exceeded, B-5 would temporarily enter batch operations.
- Pond C-2 is batch discharged to Woman Creek, which flows to the Woman Creek Reservoir, using the upgraded outlet works.

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- Pond levels and inflow rates are used to determine procedural transitions to batch mode operations.

- If the Proposed Management for ITS Water is implemented, and the 100 mg/L NO_3^- standard for NWC has been obtained, ITS water will be direct discharged to NWC with stakeholder approval.

- WWTP effluent will be selectively routed to Pond A-3 or B-3.

- Ongoing monitoring and evaluation of influent contaminants and transport mechanisms, and continued pond water discharge monitoring to assure downstream parties of water quality.

- Continued removal or stabilization of potentially mobile contaminants in watershed areas.

- Schedule of batch discharges announced to the regulators.

5.5 PHASE IV

Specific details on the operational protocol for Phase IV will be established after the final Site vision has been determined.

5.5.1 Prerequisites and Assumptions

Prerequisites and Assumptions will be determined by the details of the final Site Vision.

5.5.2 Key Components

During Phase IV pond are expected to be operated in a flow-through state with minimal active management. Water quality is expected to be maintained through physical settling of the naturally fluctuating pond volumes.

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RF/ER-96-0014.UN

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Rocky Mountain Remediation Services, L.L.C.

September, 1996

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1. EXECUTIVE SUMMARY

The Pond Operations Plan Technical Appendix (POP TA) was prepared by the U.S. Department of Energy Rocky Flats Field Office (DOE, RFFO), Kaiser-Hill, L.L.C., and Rocky Mountain Remediation Services, L.L.C. (RMRS), to provide a technical basis for the phased transitioning of pond operations from the current detention (batch) discharge mode to a managed flow through, or "controlled detention" mode of operation at the Rocky Flats Environmental Technology Site (Site).

The focus of the POP TA is on controlling the discharge of radionuclides in surface water with little attention given to non-radiochemical constituents, because the most stringent and Site-specific, water-quality goals are for the control of radionuclides. The low (less than one in one-million) increased health risk resulting from release of radionuclides was quantified by the Colorado Department of Public Health and Environment (CDPHE) in their study "Historical Public Exposures Studies on Rocky Flats," (ChemRisk, 1993). ChemRisk also concluded that the increased health risk due to non-radiochemical exposure (mainly carbon tetrachloride) is about two orders of magnitude (100 times) lower than the risk due to radionuclide (plutonium) exposure. Furthermore, regulation of non-radiochemical constituents are covered by the Site National Pollutant Discharge Elimination System (NPDES) permit, and attainment of Colorado Water Quality Control Commission (CWQCC) goals for non-radiochemical constituents has not been problematic at the Site.

The POP TA provides the technical basis for the 4-phased transition of Site stormwater detention ponds to controlled detention operations. The benefits to the proposed modes of operation include improved stormwater management through increased attenuation capacity; increased spill containment capacity; improved detention pond dam safety; enhanced water quality; improved downstream habitat; and decreased operational costs.

Controlled detention operations will increase the capability of the ponds to attenuate stormwater inflows, compared to the current batch-mode operations. Furthermore, the Site detention dams were not designed to contain large volumes of water for long periods (i.e., weeks), but were designed to detain and attenuate storm runoff. Design specifications are exceeded every time the detention dams are filled during batch-mode operations. Controlled detention operations would not eliminate dam integrity concerns, but would greatly reduce the risk of dam failure. Consequently, the overall safety of pond operations and, in turn, the overall safety of Site operations is increased.

A comprehensive stormwater management and pond management program includes identification and control of contaminated runoff sources. The identification of the contaminated runoff sources is a continuing Site activity involving coordination and implementation of the Rocky Flats Clean-up Agreement (RFCA) New Source Detection and Performance monitoring programs with other Site investigation activities, including Operable Unit (OU) investigations (e.g. OU8, OU12, and OU14).

The North and South Walnut Creek systems were modeled as ideal settling basins for evaluation of the performance of the pond system under controlled detention conditions to develop operational control criteria for controlled detention. Actual surface-water data for total suspended solids, plutonium and americium, were used in the development of this model and the results of the analysis provided the optimum operational protocol for achieving simultaneous maintenance of CWQCC standards, improved ecological health of the watershed, and maintenance of pond volumes best suited for dam structural integrity.

The POP TA contains a monitoring plan for controlled detention operations that integrates pond operations with the RFCA surface-water monitoring program. In addition to grab and composite sampling, the Site currently has capabilities to perform continuous monitoring of selected water-quality parameters in Ponds A-4 and B-5. This instrumentation allows real-time monitoring of temperature, pH, conductivity, and dissolved oxygen. These data may be transmitted from the ponds to a central monitoring and control platform to aid in decision-making for pond management. Sampling, sample analysis methods, and quality assurance protocol are detailed in this document.

Controlled detention operations will reduce algal blooms in the ponds, thereby lessening occasional pH standard exceedances, potentially eliminating current pH problems altogether. Additionally, aquatic habitat downstream from the A- and B-Series detention ponds will be improved by providing more constant flow in Walnut Creek below Ponds A-4 and B-5, versus the current sporadic flows which limit habitat conditions and the biological health of the drainage.

By modifying operational and analytical requirements associated with the current mode of operations, significant cost savings can be obtained. The need for an operations subcontractor to perform maintenance on dams and pond facilities and to conduct pond water discharges and transfers is greatly reduced by controlled detention, producing a cost savings of nearly $1M annually. Also, sampling and sample analysis costs will be reduced by approximately 50%, creating a savings of approximately $360K each year.

The POP TA uses historical Site environmental data, engineering principles, and conservative, technical assumptions to address: contaminant source areas; emergency response actions; disposition of potentially contaminated waters; the applicability of CWQCC standards (Site-specific, water quality goals); protocol for controlled detention, batch, and emergency modes of pond operations; changes in monitoring protocol germane to proposed operations; and benefits from transition to modified operations. The most significant contaminant source locations are identified and described in the POP TA with a listing of potential and ongoing mitigation activities.

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2. INTRODUCTION

This document provides the technical basis for assessing and modifying operations of the Site's stormwater detention ponds. The POP outlines a phased approach for transitioning pond operations from the current batch discharge mode to a managed flow through, or "controlled detention" mode of operation. The POP provides policy consideration and justification for modified operations, but technical considerations for operations, such as how and when to attenuate, monitor, and control pond inflows, were reserved for discussion in this TA document. This TA also provides a comprehensive view of all major programs that influence the Site aquatic resource.

There are several benefits to the proposed modes of operation, including:

- Improved stormwater management through increased attenuation capacity;
- Increased spill containment capacity;
- Improved detention pond dam safety;
- Enhanced water quality;
- Improved downstream habitat; and
- Decreased operational cost.

These benefits are discussed in detail below.

At this time, future controlled detention is only being considered for the A- and B-Series detention ponds. The South Interceptor Ditch (SID) drainage, including Pond C-2, currently is not being considered for controlled detention operation. Pond C-2 is discharged relatively infrequently, typically just one time each year. Therefore, controlled detention operations for Pond C-2 would provide little benefit. Additionally, hydraulic differences between the SID/Pond C-2 system and the A- and B-Series ponds will necessitate differing modeling assumptions and parameters. This drainage also has far less exposure to runoff from the Industrial Area (IA) than the A- and B-Series pond drainages. Modification of Pond C-2 operations, will be integrated with OU1 and OU2 accelerated cleanup activities currently being scoped and scheduled.

Ponds specifically excluded from consideration in the POP and this TA are:

- Ponds D-1 and D-2 - Smart Ditch Drainage

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- Lindsey Ranch Pond - Rock Creek Drainage

- Coyote Pond - Rock Creek Drainage near the Jefferson County gravel pits

- Other small, unnamed ponds in Woman Creek and No Name Gulch (Landfill Pond Drainage).

This document uses historical Site environmental data, engineering principles, and conservative technical assumptions to address:

- Sources of radionuclide-contaminated materials that might be transported in storm runoff to the detention ponds.

- Engineering, administrative, and maintenance controls that could be used to reduce contaminated runoff.

- Coordination with accelerated environmental restoration actions and engineered watershed improvements with changes in pond water management strategy.

- Attenuation of radionuclide contaminants in stormwater by the detention ponds, operational criteria for simultaneous maintenance of water-quality standard attainment, detention pond stormwater attenuation capacity, detention dam safety, and aquatic habitat.

- Emergency conditions which may warrant modification of pond operations to facilitate spill containment or flood control.

- Pond water treatment in the event of an emergency condition.

- Modification of surface-water monitoring programs to provide appropriate data for modified detention pond operations.

- Benefits and values associated with modified modes of operation.

The transition of the Site mission from weapons production to environmental restoration, waste management and storage, decontamination and decommissioning, and special nuclear material stabilization and storage presents new concerns as well as opportunities to enhance Site surface-water management to the satisfaction of stakeholders. Spill response and chronic release identification capabilities are continuously tuned to the changing Site mission. Identification of storm runoff contamination sources is leading to watershed improvements to control runoff water quality. Accelerated environmental restoration activities, aimed at eliminating high-risk areas, also present opportunities for runoff pollution reduction and prevention. Implementation of the TA recommendations included herein would support the accelerated transition activities proposed for the Site.

2.1 DESCRIPTION OF STUDY AREA

2.1.1 General Setting

The Site is a government owned, contractor operated facility in the DOE nuclear weapons complex, located in Golden, Colorado (Figure 2-1). The Site is owned by the DOE, managed by the DOE RFFO, and currently operated by the Kaiser-Hill Company (KH).

2.1.2 Hydrologic Setting

The Site comprises some 6000 acres of short-grass prairie and developed Buffer Zone, with approximately 398 acres of industrialized area. The Site has been, and continues to be, home to a variety of industrial uses associated with nuclear material handling and storage, and waste management. The IA drainage area is approximately 74% impervious, consisting of buildings, pavement, and fill. The surrounding Buffer Zone drainage area is less than 10% impervious. Detailed descriptions of the Site drainages are contained in the Event-Related Surface-Water Monitoring Report, Rocky Flats Environmental Technology Site, Water Year 1993 (EG&G, 1994). Smart Ditch, McKay Ditch, Upper Church Ditch, Woman Creek, Rock Creek, and North Walnut Creek are intermittent to ephemeral streams and irrigation ditches that flow from west to east across the Site. South Walnut Creek and Antelope Springs Gulch are east-flowing perennial streams that headwater on the Site.

2.1.3 Hydrogeologic Setting

The Groundwater Geochemistry Report for the Rocky Flats Environmental Technology Site, Volume III of the Sitewide Geoscience Characterization Study, (EG&G, 1995) contains a detailed description of the Site geology. Excerpts from this report are reproduced below to provide a general description of the hydrogeologic setting.

Geologic units underlying the Site include unconsolidated surficial deposits and bedrock. Detailed descriptions of these units are provided in the Geological Characterization Report (Volume I, EG&G, 1995a). Approximately 99% of the Site is covered with surficial deposits that include artificial fill, colluvial, landslide, and alluvial deposits. Colluvial and landslide deposits are most extensive. Surficial deposits range in thickness from 0 to 100 feet.

Artificial fill materials are present across the Site and include road and railroad embankments, earth dams and other engineered fills, as well as compacted and uncompacted landfills and spoil piles along some of the irrigation ditches.

Middle Pleistocene-Holocene aged colluvial deposits cover the steep hillslopes in the incised stream drainages. Middle Pleistocene-Holocene aged landslide deposits are present along steep hillslopes in the incised drainages.

The Rocky Flats Alluvium caps the pediment at the Site. These Pleistocene aged sediments were deposited as alluvial fans along the eastern edge of the Front Range. Thickness of the Rocky Flats Alluvium ranges from approximately 10 to 100 feet and is controlled by location within the fan (proximal and distal) and topography on the bedrock surface.

Bedrock units unconformably underlie the surficial deposits and consist of claystones, siltstones, and sandstones of the Upper Cretaceous aged Arapahoe Formation, Laramie Formation, Fox Hills Sandstone, and Pierre Shale. A preserved bedrock pediment exists between the major drainages of Rock Creek, Walnut Creek, and Woman Creek. The pediment surface is irregular as a result of earlier erosion.

2.1.4 Climate

The Site is in a semi-arid climate with large seasonal variations in temperature and precipitation. Summer daytime high temperatures are typically in the 80° F range with nighttime low temperatures in the 60° F range. Winter daytime temperatures typically are in the 40° F range with nighttime low temperatures in the 15° F to 25° F range.

Mean annual precipitation at the Site is about 15 inches, with most of the precipitation occurring in the months of March through June. Strong and gusting winds are common at the Site. These winds occur during November through April, peaking in January. Westerly "Chinook" wind speeds typically exceed 75 miles per hour, and gusts may exceed 100 miles per hour (EG&G, 1995). Site total precipitation from 1990 through 1994 is shown in Figure 2-2.

2.1.5 Study Area Boundaries

Spatial Boundaries

The study area boundaries for the TA are shown in Figure 2-3. Generally, the boundary will include the North Walnut Creek and South Walnut Creek drainages from the western-most extent of the IA to the outfalls of Ponds A-4 and B-5. The SID drainage extends from the southwest corner of the IA and terminates at Pond C-2.

Temporal Boundaries

The temporal boundaries for the TA are calendar years 1990 through 1995, and part of 1996. Stormwater monitoring and stream gaging information are available only after spring of 1991 through 1995, and most of 1996. Water Year 1991 and 1992 data are not of suitable quality or completeness for the modeling

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study presented herein. Therefore, use of hydrologic data for Water Years 1993, 1994, 1995, and 1996 was emphasized for the modeling study.

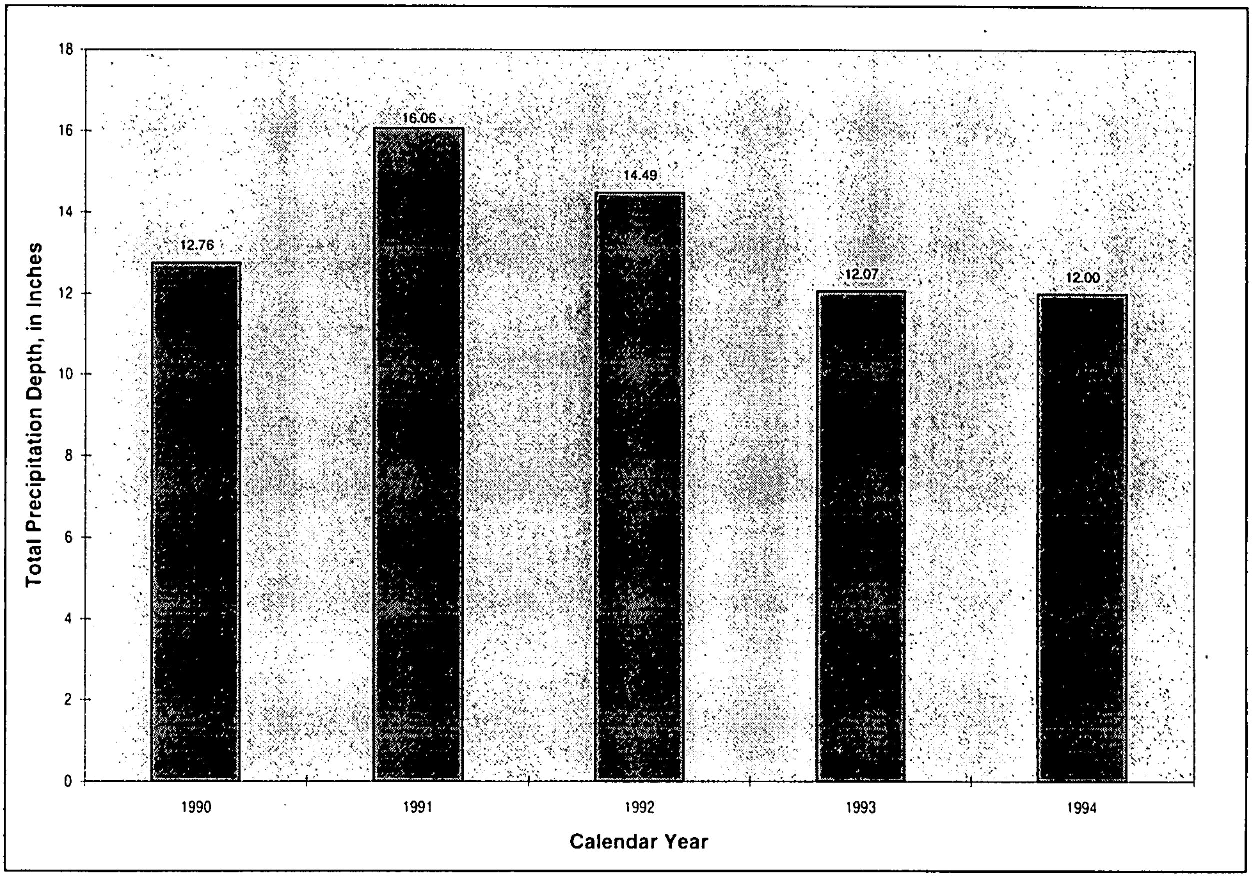

Figure 2-2. Site Total Precipitation 1990-1994; [Source: Site Environmental Monitoring Reports 1990-1994]

2.2 PRESENT POND OPERATIONS SCHEME

A plan for operation of the Site's surface water ponds, which was prepared in detail and offered to stakeholders for review, was issued in February 1994. That plan is included as Appendix A of the POP, and for the most part remains in effect. Some activities have been discontinued, such as the use of spray evaporation. This plan will be modified over the coming years in accordance with the transitional operation phases described in the POP. Additionally, historical information regarding pond operations at the Site is contained in the POP.

Generally, the current batch-and-release mode of operation involves the complete detention of runoff in Ponds A-3, A-4, and B-5. The ponds are sampled to assess and ensure that the pond water meets the CWQCC site-specific discharge standards for several constituents, including Plutonium (Pu) and Americium (Am), the primary contaminants of concern in Rocky Flats surface waters. The batch and release mode of pond operation is by far the most conservative approach to controlling water quality standard attainment. However, the batch and release operations limit pond capacities for spill and stormwater containment, challenge the structural integrity of the dams, and limit flow to downstream habitat, thus limiting ecological use attainability.

2.3 BENEFITS TO PROPOSED POND OPERATIONS

Many benefits will result from the transition to controlled detention operations of the ponds. Generally, these benefits are categorized by: stormwater attenuation and containment benefits; dam safety benefits; water-quality benefits; logistical simplifications; ecological benefits; and operational cost benefits.

2.3.1 Stormwater Attenuation and Containment Benefits

Maintaining the ponds at low volumes of 10 to 20 percent provides increased capacity for managing stormwater, and capturing contaminants accidentally released upstream of the ponds. In batch-mode, the ponds normally contain 30 to 60 percent of their total capacity. Therefore, up to a three-fold increase in containment capacity can be achieved by the proposed modified operations.

2.3.2 Dam Safety Benefits

The Site detention dams were not designed to contain water for long periods (i.e., weeks); rather they were designed to detain and attenuate storm runoff. Design specifications are exceeded every time the detention dams are filled during batch-mode operations. Care must be taken to ensure the stability of the dam to prevent dam failure. Therefore, the dam capacity is closely monitored to prevent threatening the emergency spillways, and pumping or discharge rates are adjusted to no more than one foot per day water-level drawdown to prevent slumping of the saturated upstream dam face. The dam toes are monitored for leakage, which would be an indicator of potential dam failure. The transition to controlled detention operations does not eliminate dam integrity concerns and associated protocol that addresses those concerns, but this transition greatly reduces the risk of dam failure. Consequently, the overall safety of pond operations and, in turn, the overall safety of Site operations is increased.

2.3.3 Water-Quality Benefits

Currently, nutrient rich Pond B-5 water is transferred to Pond A-4 where the water sits stagnant until discharge. Stagnation of the nutrient-rich water creates algal blooms which upset carbonate equilibria; resulting in high pH of the Pond A-4 water. The CWQCC pH standard of 9.00 is routinely exceeded

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during summer months. Future pond operations will minimize pH standard exceedance, and it may eliminate the current pH problems altogether.

2.3.4 Ecological Benefits

Future pond operations will increase the occurrence of aquatic habitat downstream from the A- and B-Series detention ponds by allowing for more frequent discharges. The Biological Assessment for Walnut Creek and Woman Creek (EG&G 1995) indicates that limited flows in Walnut Creek below Ponds A-4 and B-5 are limiting habitat conditions and biological health of the drainage. The Biological Assessment further indicates that the quality of the Walnut Creek aquatic habitat is limited due to lack of riparian overstory and stream substrate conditions; preventing Walnut Creek from achieving the same biological health as the Woman Creek drainage. It should also be noted that modified pond operations could decrease the amount of wetland acreage in the detention ponds themselves. Nonetheless, the first step in attaining potential ecological benefits in Walnut Creek is to allow for more frequent stream flow in the creek channel.

Wetland Functions and Values

The change to a controlled detention system from the current batch discharge pond-water management system would be expected to have some effect on the functions and values of the wetlands downstream from the A- and B-Series ponds. For purposes of this discussion, wetland functions are defined as the physical, chemical and biological processes or attributes of a wetland, without regard to their importance to society (Adamus, et al., 1987). Wetland values are defined as wetland processes or attributes that are valuable or beneficial to society (Adamus, et al., 1987). Wetland values are determined by the functions they perform.

The following are examples of wetland functions and values that may be performed by wetlands downstream of the A- and B-Series ponds. Site specific information would be required to determine the extent to which specific functions or values are relevant to the wetlands downstream from the ponds.

- Ground Water Recharge
- Nutrient Export
- Ground Water Discharge
- Wildlife Habitat
- Floodwater Retention
- Aquatic Habitat

- Sediment Stabilization
- Recreation
- Sediment/Toxicant Retention
- Aesthetics
- Nutrient Removal/Transformation

The change to a controlled detention system, from the current batch discharge, would likely result in some change to the vegetation downstream from the ponds. If flows are consistent enough to saturate soils along the edges of the stream, vegetation that can tolerate saturated soil conditions will gradually replace any existing vegetation that can not tolerate saturated soils. Generally, increases in wetland vegetation would result in increased wetlands functions and values. As vegetation along Walnut Creek changes, the wildlife habitat provided by the vegetation would also change. If wetland vegetation along stream channels increases, birds and animals that prefer wetland habitat would also be expected to increase. The Preble's Meadow Jumping Mouse, a species that is currently a candidate species proposed for listing under the Endangered Species Act (ESA), has been found along Walnut Creek downstream from the ponds. Habitat for this species would be expected to increase and improve under a controlled detention system.

Aquatic habitat should be improved by more continuous flows, even though there is no guarantee that the flows would be of sufficient frequency or duration to support permanent populations of fish. Increased flow frequency should at least result in an increase in aquatic invertebrates and other aquatic and semi-aquatic organisms that can survive and reproduce under periodically dry conditions.

Effects resulting from the change in pond water management should be restricted primarily to wetlands that are located in and along the stream channel. Wetlands that are located at higher elevations in the landscape, along the side slopes, should not be directly affected since these wetlands are supported by either ground water or surface flows that will not be affected by the proposed changes.

2.3.5 Cost Benefits

Current pond operations costs for batch discharge operations are nearly $1.75M annually. These costs include: a pond operations subcontractor; subcontracted pond-water sampling; water sample analysis; data analysis and reporting; and administrative and project management labor. Approximately 80% of these costs will be eliminated by transition to controlled detention operation. The need for an operations subcontractor, to perform maintenance on dams and pond facilities and to conduct pond water discharges and transfers, would be greatly reduced in controlled detention mode, producing a majority of the cost savings - nearly $1M annually. Sampling and sample analysis costs will be reduced by approximately

50%, creating a savings of approximately $360K each year. The sampling and sample analysis savings are in excess of savings already realized by the transfer of pond water monitoring responsibilities to the CDPHE.

2.4 CRITERIA FOR CURRENT POND OPERATIONS

Current pond operation in a batch and release mode is based on several criteria and competing concerns to simultaneously ensure water-quality standard attainment while ensuring dam safety, adequate stormwater and spill containment capacity, and coverage of sediments with water.

2.4.1 Water Quality Standards

Pursuant to its authority under the Colorado Water Quality Control Act, the CWQCC determines the appropriate use classification for state waters, as well as the appropriate water quality standards. These standards have either statewide applicability, or can be specific to certain stream segments or selected sites, the site-specific standards. The Site is subject to both statewide and site-specific standards. Usually, site-specific standards are more stringent than the statewide standards, but site-specific standards can also be established for parameters where no state standard has been adopted. A complete listing of statewide and site-specific standards, including a listing of all water ways within the state and the approved use classifications, can be found in the Colorado Code of Regulations.

Stream standards are enforced in part through discharge permits issued to point sources, either by the Environmental Protection Agency (EPA) or by a state through an EPA delegation under the Clean Water Act (CWA). Since Colorado has not received delegation of the authority to issue discharge permits to federal facilities, EPA has issued RFETS its permit. However, Colorado must certify, under section 401 of the CWA, that the EPA-issued permit will protect state waters. Permit writers typically enforce applicable stream standards by including discharge limits, either equivalent to the standard or modified based on the size of the receiving water in comparison to the effluent sources of pollution to the receiving water. In the case of RFETS, EPA has drafted a permit which contains discharge limits for 25 parameters, most of which directly reflect the applicable stream standard. Those parameters are listed in Table 2-1.

Table 2-1. Parameters with Discharge Limitations in the 1995 Draft NPDES Permit for the Site

- CBOD5
- Total Suspended Solids
- Fecal Coliforms
- Oil and Grease
- Total Residual Chlorine
- Nitrate plus Nitrite
- Total Phosphorus
- Ammonia
- Chromium, Total Recov.
- Chromium, Hexavalent
- Silver
- Gross Alpha
- Gross Beta
- Americium
- Plutonium
- Tritium
- Uranium
- Benzene
- Carbon Tetrachloride
- Chloroform
- Dichloroethane
- Dichloroethylene
- Dichloroethylene
- Tetrachloroethylene
- Trichloroethane
- Trichloroethylene

Of these 25 parameters, Pu and Am cause the greatest concern to the stakeholders. Therefore, these two radionuclides are the focus of this TA; organics, metals and other contaminants will not be directly addressed. To properly address all potential contaminants would far exceed the scope and intent of this document. Historic sampling records for drainage flows upstream of the A- and B-Series ponds show that exceedances for most other listed parameters are rare and typically minor. However, it should be noted that many of the source control, spill containment, and water quality monitoring practices, as well as watershed improvements discussed herein, effectively control parameters other than radionuclides.

Authority to control radionuclide release into the environment is shared between the EPA and the DOE. While EPA can establish limitations on radionuclides under the Clean Air Act and the Safe Drinking Water Act, radionuclides in source, by-product and special nuclear material are not pollutants under the CWA. Instead, the discharge of such radionuclides into waters of the U.S. is regulated exclusively the Atomic Energy Act (AEA). Under the AEA, DOE is responsible for establishing the discharge levels at its defense facilities. DOE has participated in the proceedings of the CWQCC as a matter of comity, but has consistently argued that EPA does not have authority to enforce the state standards either directly under the CWA or as ARARs under CERCLA. As a result, the radionuclide water quality standards that the CWQCC has adopted are in effect, but their enforceability at RFETS is a matter of substantial controversy. However, because RFETS is currently operating under a permit originally issued in 1984, none of the state water-quality standards adopted in the last decade have been incorporated into an enforceable permit for the Site.

This TA used the state-adopted stream standards as goals which guide source-control activities and watershed management strategies. Descriptions of water quality data as constituting exceedances of stream standards reflect circumstances where the underlying ambient conditions show higher levels of Pu and Am than the data that the CWQCC used in 1989 to establish its water quality standards. Because there is no present enforcement mechanism for the State's water quality standards at the Site, and because in many cases the data reflect instream conditions unaffected by any present discharge from RFETS operations, exceedances are not violations of any permit condition or other applicable legal requirement.

2.4.2 Operational Pond Capacity

During routine operation of Ponds A-3, A-4, and B-5, the objective has been to maintain the volumes at 10% of maximum capacity - the design basis for short-term detention earthen dams. Pond capacities of 10% satisfy the goal of keeping the sediments covered while maximizing stormwater or spill containment capacity. Several factors cam make maintaining the 10% capacity level impractical:

Pond A-4 is isolated under batch and release mode. Delays due to analytical turnaround and the discharge approval process for A-4 cause Ponds B-5 and A-3 to routinely reach 40-60% capacity with the inherent continuous inflows of treated wastewater effluent and stormwater.

Pond A-4 is pump-discharged down to 10% capacity, but it must routinely be filled to 40-60% capacity after receiving transfer and discharge water from Ponds B-5 and A-3, at which point B-5 and A-3 are returned to 10% capacity.

As recommended by the Colorado Department of Reclamation - State Engineers Office (SEO), the drawdown rate of the ponds during transfer or discharge events must not exceed one foot of elevation per day to prevent saturated soils in the dams from sloughing. Complying with this recommendation extends the period for each discharge cycle by several days.

As a result of these factors, the 10% capacity level is attained only at the conclusion of each transfer or discharge event.

2.4.3 Evaluation of Terminal Pond Capacities

On March 28, 1996, KH Civil Engineering provided RMRS Surface Water with the following analysis of studies that were conducted to evaluate the capacity of the Site's terminal detention ponds.

The Dams at Ponds A-4, B-5, and C-2, built in 1979/80, were designed to store the 100 year, 3 day storm event, as determined at that time, per the design drawings 27165-210, -220, and -230. The freeboard (distance between maximum water surface elevation and spillway) was 3.3 feet at A-4, 1.7 feet at B-5, and 4.3 feet at C-2. Subsequent modifications were made to Dam B-5 in 1984 with the capability of retaining the 100 year, 3 day storm event maintained with 1.4 feet of freeboard, per the modification drawing 28895-001. There is no actual required storage capacities for these reservoirs in accordance with 2 CCR 402-1, "Rules and Regulations for Dam Safety and Dam Construction".

A capacity study and topographic survey was performed by Merrick & Company in 1990-1991 to determine any changes to the dam and spillway elevations and the storage capacity of the ponds. A storage-capacity curve was generated for each pond (drawings 39873-007, -015, -020). This is the information currently used for determining the capacity of the ponds.

Drainage studies have been conducted by various entities in recent years that would reflect changes to the drainages on the site since the time the dams were built, including the 1992 Master Drainage Plan, completed by Write Water Engineers (MDP) and "Storm-Runoff Quantity for Various Design Events, 1991, Advanced Sciences Inc." (ASI). Both were used for this evaluation of the approximate current storm capacity for Ponds A-4, B-5, and C-2. These drainage analyses were performed by separate entities with different modelers, techniques, and limitations and assumptions, and, as would be expected, produced slightly different resulting volumes for various storm events. A comparison and evaluation of these differing results was not conducted for this evaluation. As a conservative measure without further evaluation of the studies, the study that yielded the greatest run-off volume should generally be used for the final determination of the storm event capacity. The MDP is limited in the fact that a storm event of 6 hour duration only was used, whereas the ASI study included 6, 24, and 72 (3 day) hour duration events, thereby giving a run-off volume for the 100 year, 3 day event that can be compared to the volume for this event and duration used for the original design. Excerpts showing the run-off volumes produced by MDP *and ASI studies are attached, as well as an excerpt from the MDP comparing the MDP and ASI studies and noting some of the differences between the studies.*

An evaluation of the ASI study versus the hydrologic study used for the dam design was not conducted. The ASI 3 day storm event produced volumes for all three dams that were significantly higher than those from the original dam design drawings. This is likely due, again, to the different entities performing the study, as well as to changes to the Site itself since that time.

The attached charts entitled "A-4, B-5, and C-2 Storm Event Capacity" list the percent of the 100 year storm event that each pond is capable of retaining at a given elevation and capacity (percent full). Data are included for the MDP 6 hour duration, and for the ASI 6, 24, and 72 hour duration events. The design and ASI 100 year, 3 day storm event, and the capacity of the ponds in relation to the MDP and ASI 100 year storm events, is discussed below.

Table 2-2. Pond capacity information based on several different engineering analyses.

Pond	Capacity Study	Starting Capacity (%)	Event Duration	Capacity (Acre-Feet)	Percent of Runoff Retained	Resulting Freeboard (Feet)
A-4	Original Design	0	72 hour	70	100	0
A-4	ASI	0	72 hour	160	100	0
A-4	MDP	35.7	6 hour	64	100	0
A-4	MDP	0	6 hour	64	100	4.6
A-4	ASI	26.5	6 hour	73	100	0
A-4	ASI	26.5	6 hour	73	100	3.3
A-4	ASI	0	24 hour	130	77	n/a
A-4	ASI	0	72 hour	160	62	n/a
B-5	Original Design	0	72 hour	71	100	0
B-5	MDP	3	6 hour	71	100	0
B-5	MDP	0	6 hour	71	100	1.4
B-5	ASI	12	6 hour	65	100	0
B-5	ASI	0	6 hour	65	100	1.4
B-5	ASI	0	24 hour	100	74	n/a
B-5	ASI	0	72 hour	130	57	n/a
C-2	Original Design	0	72 hour	42	100	0
C-2	MDP	61	6-hour	28	100	6.2
C-2	ASI	36	6-hour	45	100	3.2
C-2	ASI	0	24 hour	220	32	n/a
C-2	ASI	0	72 hour	240	29	n/a

Note: MDP = Master Drainage Plan; ASI = Advanced Sciences, Inc. Zero Discharge Study; Original Design = the designed capacity of the ponds when the ponds were first designed for construction.

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Pond A-4:

The 100 year, 3 day storm event, as determined at the time of the dam design, was 70 acre-feet. The ASI volume for this event is 160 acre-feet. The pond is capable of retaining 100 year storm events of various durations as follows:

MDP 100 year, 6 hour (64 acre-feet): The pond can retain this event if the pond is at a capacity of approximately 35.7% (with no freeboard) or lower. The pond, if empty, will retain this event with approximately 4.6 feet of freeboard.

ASI 100 year, 6 hour (73 acre-feet): The pond can retain this event if the pond is at a capacity of approximately 26.5% (with no freeboard) or below. The pond, if empty, will retain this event with approximately 3.3 feet of freeboard.

ASI 100 year, 24 hour (130 acre-feet): The pond cannot retain this entire event. The pond can retain approximately 77% of this event if the pond is empty.

ASI 100 year, 72 hour (160 acre-feet): The pond cannot retain this entire event. The pond can retain approximately 62% of this event if the pond is empty.

Pond B-5:

The 100 year, 3 day storm event, as determined at the time of the dam design and at the time of the modification, was 71 acre-feet. The ASI volume for this event is 130 acre-feet. The pond is capable of retaining 100 year storm events of various durations as follows:

MDP 100 year, 6 hour (71 acre-feet): The pond can retain this event if the pond is at a capacity of approximately 3% (with no freeboard) or lower. The pond, if empty, will retain this event with approximately 0.4 feet of freeboard.

ASI 100 year, 6 hour (65 acre-feet): The pond can retain this event if the pond is at a capacity of approximately 12% (with no freeboard) or below. The pond, if empty, will retain this event with approximately 1.4 feet of freeboard.

ASI 100 year, 24 hour (100 acre-feet): The pond cannot retain this entire event. The pond can retain approximately 74% of this event if the pond is empty.

ASI 100 year, 72 hour (130 acre-feet): The pond cannot retain this entire event. The pond can retain approximately 57% of this event if the pond is empty.

Pond C-2:

The 100 year, 3 day storm event, as determined at the time of the dam design, was 42 acre-feet. The ASI volume for this event is 240 acre-feet. The pond is capable of retaining 100 year storm events of various durations as follows:

MDP 100 year, 6 hour (28 acre-feet): The pond can retain this event if the pond is at a capacity of approximately 61% (with no freeboard) or lower. The pond, if empty, will retain this event with approximately 6.2 feet of freeboard.

ASI 100 year, 6 hour (45 acre-feet): The pond can retain this event if the pond is at a capacity of approximately 36% (with no freeboard) or below. The pond, if empty, will retain this event with approximately 3.2 feet of freeboard.

ASI 100 year, 24 hour (220 acre-feet): The pond cannot retain this entire event. The pond can retain approximately 32% of this event if the pond is empty.

ASI 100 year, 72 hour (240 acre-feet): The pond cannot retain this entire event. The pond can retain approximately 29% of this event if the pond is empty.

The information in Table 2-2 indicates that the ponds will hold 100 year design storm events of selected magnitude and duration. In addition to the pond capacity study methods described above, Merrick and Company performed a capacity study which generated the current capacity curves used today to convert pond water elevation to a percent full capacity value.

2.5 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are developed for environmental characterization projects to ensure that the data acquired are necessary and sufficient to support environmental management decision making. This TA synthesizes all available data from many Site monitoring and investigative programs; all with different DQOs. For example, Phase I Remedial Investigation chemical analysis data (e.g., soil, water and sediment quality data) typically are Level IV quality data; employing well-documented and approved sampling and analysis protocol and independent validation. Other data are Level I and II quality data which provide only a screening or observation type of a measurement. The intent of this document is to use all available data, regardless of their associated level of quality control, to build consensus regarding management decisions associated with proposed pond operations.

Future Site water monitoring will be guided by the requirements of RFCA as documented in a Site Integrated Monitoring Plan (IMP). The IMP currently is in development using the DQO Process. DOE, Site contractors, local communities, the State, and the EPA all have equal input to defining the DQOs for the IMP. RFCA compliance monitoring, as defined by the IMP, will provide data for pond operations management and decision making effective October 1, 1997.

3. SPILL RESPONSE AND COUNTERMEASURES

3.1 EMERGENCY RESPONSE ORGANIZATIONS

Emergency response planning efforts at the Site, including spill response, are coordinated by the Emergency Preparedness group. First response to spills is performed by Emergency Services, which includes the Site Fire Department and Hazardous Materials (HAZMAT) Team. Both the Emergency Preparedness and Emergency Services groups are part of DynCorp of Colorado. Additional on-site organizations, including RMRS Sitewide Surface Water Group, provide support to the first response teams, as needed, depending on the nature of the spill.

3.2 COMMUNICATION / NOTIFICATION ORGANIZATION FOR SPILL CONTROL AND SURFACE WATER PROTECTION AT ROCKY FLATS

A protocol for notification and response to detected releases is established in Site procedures as described in Section 3.4.8. The interaction between Site organizations, DOE, State and Federal regulatory agencies, and neighboring communities for conducting appropriate notification and response actions is illustrated in Figure 3-1 and Figure 3-2.

3.3 SPILL RESPONSE

Site personnel have been trained to report all unplanned releases to their supervisors regardless of quantity. Non-emergency releases are reported directly to the Shift Superintendent. A release that is uncontrolled or life-threatening is reported immediately to Site extension 2911, which rings through to the Shift Superintendent, Fire Department, Emergency Operations Center (EOC), Protective Forces, and Occupational Health. Site procedures for reporting and control of spills are listed in Section 3.4.8

If hazardous materials are involved in the spill, the HAZMAT Team is dispatched to the spill site. The HAZMAT Team executes first response tasks, including designating safe and restricted areas, containing and controlling the release, determining if secondary response is needed, performing initial cleanup activities, and ensuring efforts are made to assist in the remediation of the site. Concurrent with the HAZMAT Team spill containment and cleanup activities, Waste Regulatory Programs (WRP) personnel respond to all spills to determine whether or not the spill is reportable under Resource Conservation and Recovery Act (RCRA) guidelines, if the release could impact the environment, and to coordinate follow-up to spill cleanup activities.

Other organizations may become involved in a spill cleanup, depending on the nature of the release. A partial list of these supporting groups includes Health Physics, Industrial Hygiene, Utilities, Heavy Equipment and Trucking, Chemical Operations, Security, and Waste Management. If the release could potentially impact surface water, then the SSW provides support.

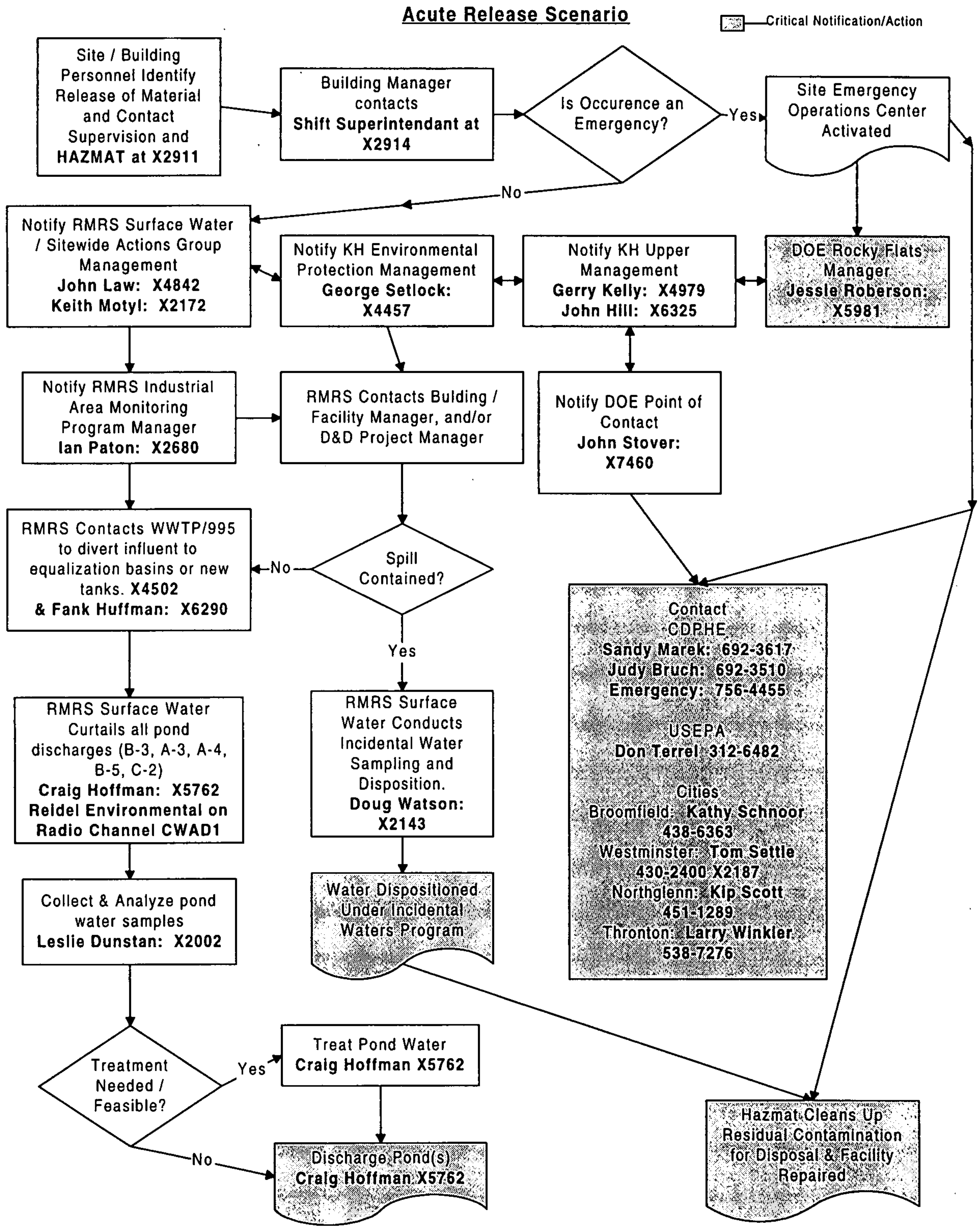

Figure 3-1. Communication / Notification Diagram for Spill Control and Surface Water Protection at Rocky Flats: Acute Release Scenario

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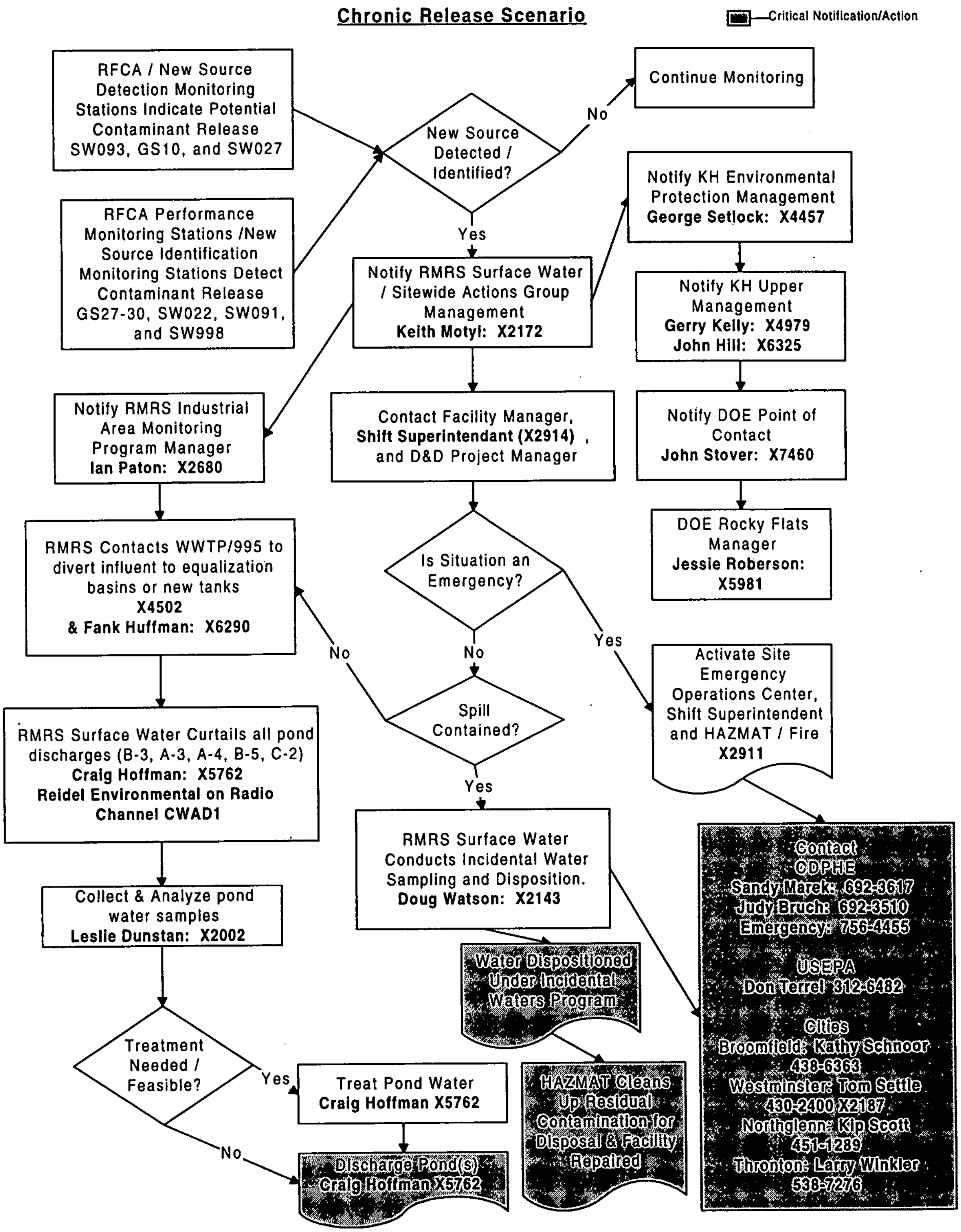

Figure 3-2. Communication / Notification Diagram for Spill Control and Surface Water Protection at Rocky Flats: Chronic Release Scenario

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3.4 SPILL FIRST RESPONDER PERSONNEL

3.4.1 Shift Superintendent

There are six Shift Superintendents (SS) at the Site. At least one SS is present on a 24-hour basis, seven days per week. The SS or immediate supervisor, shift manager, Operations Manager (OM) or OM designee are the first contacts for reporting a spill or release to the environment.

3.4.2 HAZMAT Team

The Hazardous Materials Team, composed of Fire Department employees thoroughly trained in emergency response, is the immediate respondent to any Site incident involving the release of radioactive, toxic, or hazardous materials to the environment. During the past year, the HAZMAT Team average response time, from receiving the call to arriving on the scene, was 2 minutes and 30 seconds (Parker, 1995).

Respective responsibilities during a response action are set forth in the Fire Department Standard Operating Procedures Manual, Volume 5 of which pertains to hazardous materials. In addition to Fire Department instruction, HAZMAT team members are required to complete hazardous materials training through the Colorado Safety Institute 80-hour Level I course and 24-hour awareness course. The initial training is supplemented at least annually by 24 hours of additional training. Training records are kept for all HAZMAT response personnel by the Fire Department.

3.4.3 Spill Response Equipment

HAZMAT Team

The HAZMAT Team maintains HAZMAT 1, a fully equipped hazardous materials response truck, and Mobile 1, a hazardous material response supply trailer. The equipment and apparatus are inspected weekly by emergency response personnel and completed checklists are maintained by the Site Fire Department Emergency Services Department.

OU2 Equipment

Spill response supplies and equipment are stored at the OU2 trailer located near the east entrance to the IA.

Other Equipment

Smaller spill kits are maintained within buildings throughout the IA. Maintenance of these supplies is the responsibility of each Building Manager. Spill containment supplies are also maintained near Pond A-4 by RMRS. These supplies may be quickly dispatched to Ponds B-5 and C-2 if needed.

3.4.4 Additional Spill Containment Measures

In the event the HAZMAT Team effort to contain a spill is unsuccessful and it appears the spill may migrate to the plant drainages, culverts immediately downstream of the spill are blocked to prevent further spread of contamination. If necessary, appropriate spill diversion procedures are implemented to contain pollutants in specific detention ponds. Ponds A-1, A-2, B-1, B-2, and C-2 may serve as spill control ponds if no other alternatives are available. A procedure, Containment of Spills Within the Rocky Flats Drainages (1-C90-APR-SW.03), describes operation of the gates and valves necessary to control runoff, floods, and spills originating both upstream and on the Site (EG&G, 1994b). In general, uncontrolled releases occurring in the 700 Complex area will be diverted to Ponds A-1 or A-2. Releases in the northern portions of the 400 and 800 Complexes, the 900 Complex, and the central portion of the IA will be diverted to Pond B-1 or B-2. Releases occurring in remaining areas of the IA would ultimately be routed into Pond C-2 via the SID. It should be noted that every effort would be made to contain a spill upstream before routing contaminated water into one of the detention ponds.

3.4.5 Notifications

After the OM and SS have been notified, the occurrence is categorized per procedure as an Emergency, Unusual Occurrence, or an Off-Normal Occurrence, and approval is given to the Emergency Operations Center Notification Officer (EOCNO) to make appropriate notifications. The EOCNO staff makes on-site and off-site verbal and written notifications as outlined in the Occurrence Notification Process procedure. WRP staff provide technical assistance, as required, in determining which regulatory agencies must be notified.

3.4.6 Spill Response Training Exercises

Exercises are a key element of the DOE emergency management program and are conducted at the Site to develop, maintain, test, and evaluate response capabilities of personnel, facilities, equipment, procedures, and training under simulated conditions as dictated by DOE Orders 5500.1B and 5500.3A. Two types of drills are conducted at least annually that relate specifically to spill response. First, the HAZMAT Monitoring Drill involves monitoring, collecting, and analyzing sample media (water, vegetation, soil, or air) and takes into consideration requirements for decontamination, communications, and handling of worker exposure records. Second, all buildings on-site that contain HAZMAT are subject to building-specific HAZMAT Drills.

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3.4.7 Incidental Waters

Operation of the Site involves many activities which may result in incidental waters that require onsite treatment, or discharge to storm drains or the ground. These waters may originate as surface water, groundwater, fire suppression water, or wastewater and accumulate in locations such as:

- Excavation sites, pits, or trenches;
- Secondary containments or berms;
- Process waste valve vaults;
- Electrical, telephone, and alarm vaults; and
- Utility pits.

These waters may come in contact with contaminants such that water quality parameters exceed acceptable levels.

Incidental waters are managed in accordance with the procedure Control and Disposition of Incidental Waters (1-C92-EPR-SW.01) (EG&G, 1993a). This procedure ensures that incidental waters are properly controlled, sampled, and analyzed, and that the appropriate treatment or discharge method is determined. The procedure requires that water quality parameters for incidental waters meet the following control limits for discharge to the environment.

- Gross Alpha $\leq$ 40 pCi/L
- Gross Beta $\leq$ 50 pCi/L
- pH 6.0-9.0
- Nitrates as N $\leq$ 10 mg/l
- Conductivity $\leq$ 700 μmho/cm

These levels are based on state and federal water quality standards. The radiochemical limits are imposed internally by RMRS SSW to ensure that receiving water-quality is not impacted due to incidental water release to the environment.

If an incidental water is found to be unsuitable for discharge to the environment, the water is routed to the appropriate treatment facility, such as the Site Waste Water Treatment Plant (WWTP), Building 374, or the Building 891 facility.

3.4.8 Documents Supporting Spill Response

Several documents and procedures outline and detail spill response activities at the Site. Three planning documents that address spill control include the Spill Control Countermeasures and Best Management Practices (SPCC/BMP) Plan (EG&G, 1992a), the Oil Pollution Prevention Plan (OPPP) (EG&G, 1994c), and the Storm Water Pollution Prevention Plan (SWPPP) (EG&G, 1994d).

The SPCC/BMP Plan, prepared in support of the NPDES permit, provides an overview of programs, plans, and procedures that address spill prevention and response at the Site. Specific requirements for the SPCC/BMP Plan are set forth in the Site NPDES permit. The Plan combines the SPCC requirements of 40 CFR 112 and the BMP requirements of 40 CFR 125. The SPCC portion of the plan addresses procedures and design criteria for primary containment and spill prevention, as well as response to spills which occur. The BMP portion of the plan addresses prevention of water pollution from sources ancillary to the industrial manufacturing process. BMPs are broad and may include processes, procedures, human actions or construction (EG&G, 1992a). The SPCC/BMP Plan is kept onsite, available for review by the permitting authority, and revised every three years. In the event of a Site spill, the spill-related programs, plans, and procedures documented in the SPCC/BMP Plan, not the SPCC/BMP itself, should be referenced for specific guidance.

The OPPP, prepared in support of the SPCC/BMP, addresses spill response related to small, medium, and worst-case oil spill or discharge scenarios. The draft SWPPP, currently required by the new draft NPDES permit, addresses spill prevention and response and identifies potential sources of stormwater pollution at the site.

Several Site procedures are specifically intended to control spill response activities at the Site. Site emergencies, in general, are addressed by the Rocky Flats Plant Emergency Plan (1-15200-EP-01.00) (EG&G, 1992b). The HAZMAT Team is directed by the Rocky Flats Fire Department Hazardous Materials Team Standard Operating Procedures (EG&G, 1990). Procedures related to HAZMAT Team follow-up work include Release Response and Reporting (1-C49-HWRM-04) (EG&G, 1993b), Containment of Spills Within the Rocky Flats Drainages (1-C90-EPR-SW.03) (EG&G, 1994b), Occurrence Categorization (1-15200-ADM-16.02) (EG&G, 1992c), and Occurrence Notification Process (4-15230-EPIP-04.02) (EG&G, 1992d). Proper performance of drills is documented in Site Drills (1-A35-5500-12.02) (EG&G) and Building Drills (1-A35-5500-12.02) (EG&G).

3.5 INDUSTRIAL AREA SURFACE WATER MONITORING

Site monitoring initiated in 1995 as part of the IA IM/IRA, and continuing under RFCA, is being implemented to monitor the environmental consequences of Transition activities at the Site. Such transition activities include, but are not limited to, the removal of building contents, waste storage areas, and in some cases, entire buildings or facilities from the Site. Transition activities present the potential for release of materials to the environment. Monitoring transition areas provides an early-warning mechanism for controlling releases and evaluating the extent of potentially harmful affects from such releases.

The Site surface-water monitoring strategy uses a tiered approach, where tiers of increasing monitoring resolution are defined by drainage basins of decreasing drainage area.

- RFCA Point of Evaluation (POE) and New Source Detection (NSD) monitoring consists of automated, continuously recording stream gaging stations which monitor all surface-water leaving the IA. There are 3 stations that will be used for monitoring water for comparison to Site Action Levels (POE), and 2 NSD stations.

- RFCA Performance monitoring consists of gaging stations in and around Transition sub-basins to provide a high resolution of monitoring for potential releases of materials from those areas. Performance monitoring locations are installed based on specific Transition project specifications.

The monitoring stations provide continuous flow record and runoff water-quality samples for the Site Industrial Area. The POE and NSD monitoring stations are equipped with water-quality probes to measure continuous pH, turbidity, temperature, and conductivity in Industrial Area runoff. Data are evaluated to detect trends in runoff water quality that might indicate chronic release of contaminants to the watershed. The monitoring program also establishes a runoff water-quality baseline for comparing runoff quality before and after transition and/or pollution prevention activities occur. RFCA outlines the process for responding to the detection of releases using the monitoring network.

3.6 INTERNAL WASTE STREAMS

An internal waste stream is any source of non-domestic discharge which is routed to the WWTP system. Internal waste streams constitute a potential source of pollutants that may interfere with wastewater treatment operations. Pass-through of untreated pollutants could lead to exceedances of applicable water quality standards or NPDES effluent limitations, and the contamination of WWTP sludge could limit future uses or disposal practices. Internal waste streams may be subject to regulation under the NPDES permit.

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To properly implement an effective Internal Waste Stream Program Management Plan, all industrial or non-domestic waste discharges must be identified and regulated. The discharge must be identified as to the general wastewater characteristics that could adversely impact the performance of the WWTP, endanger operations personnel, and/or pass-through and degrade the quality of wastewater effluent.

Each building at the Site which produces non-domestic waste streams maintains a Waste Stream and Residue Identification and Characterization (WSRIC) book. Within the book, each waste stream in the building is identified by location, monitoring point, frequency of sampling, and the residue description and characterization of the discharge component(s). The WSRIC book can be used to determine the significant pollutants discharged by the industrial buildings that should be monitored and controlled to protect the integrity of the wastewater system and assure compliance with effluent quality limitations.

To prevent or reduce the potential for harmful or inappropriate discharges to the WWTP, the general pretreatment regulations from 40 CFR 403 are used as guidelines in the control of internal waste streams.

3.7 NPDES FFCA ACTIVITIES

The NPDES Federal Facilities Compliance Agreement (FFCA) is promulgated under Executive Order 12088 between DOE and EPA Region VIII. The NPDES FFCA was signed in March 1991 to achieve and maintain Site compliance with the water pollution control standards of the CWA. The NPDES FFCA includes revisions in the NPDES monitoring requirements and preparation of three compliance plans which address spill and water management improvements; (1) the Ground Water Monitoring Plan, (2), Upgrades to the Waste Water Treatment Plant, and (3) the Chromic Acid Incident Plan (CAIP). All components of the Ground Water Monitoring Plan have been completed. Six of seven components of the WWTP Upgrades are complete and implemented with the remaining activities on schedule to meet regulatory agency requirements. Four of the six components of the CAIP have been completed. The remaining two activities: the Drain Identification Study (DIS) and the Tank Management Plan (TMP), will be completed in the very near future.

3.7.1 Drain Identification Study

The DIS project inspects drains at the Site to identify possible pathways to the Waste Water Treatment Plant to avoid inadvertent discharges of hazardous materials into sanitary drain systems. The DIS will be re-scoped and completed during FY96.

3.7.2 Tank Management Plan

The TMP is a comprehensive aboveground storage tank inventory, integrity assessment and data tracking program. The inventory of all tanks at the Site was completed and 88% of the initial integrity testing was completed at the end of fiscal year 1995. Responsibility for routine integrity assessments is being transferred to building owners for completion of the FFCA requirements.

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3.8 SCENARIO FOR RADIONUCLIDE SOLUTION RELEASE TO WWTP

Stakeholders are concerned about the potential for a release of material from the industrial area reaching the environment through the sanitary collection system and the WWTP. The risk of such occurrences is extremely small due to programs such as the Drain Identification Study implemented through the NPDES Federal Facilities Compliance Agreement (FFCA). This program identified and plugged all existing drains located in areas containing tanks of liquids that, if spilled, would eventually flow to the WWTP. Furthermore, the remaining tanks of liquids that would have any potential to spill are secondarily contained or bermed, and many are under constant surveillance by Site personnel. The liquids of concern are nitrate solutions of either plutonium or uranium isotopes.

According to Site personnel responsible for radiological solution tank draining projects, the Secretary of Energy has mandated that the last tanks of radioactive liquids are to be drained by May 1998 (DynCorp, oral communication, 1996). After this date, the Site estimates that approximately 1,500 liters of residual radioisotope-containing liquids will be contained within pipes, fittings, tank bottoms, and other parts of industrial process piping. This configuration will further reduce the potential for residuals to escape to the environment.

In order to evaluate the worst possible accidental release of liquids to the WWTP along with the response actions and associated environmental impacts, a tank of plutonium nitrate solution in Building 771 was selected for analysis. The tank contains 146 Liters of plutonium nitrate solution at a concentration of 140 grams / Liter. A catastrophic release of this material is not a credible disaster, but as a hypothetical event, the entire quantity of material is transported conservatively through the sanitary collection system, and the following scenario would unfold.

1. Within four hours of the release to the collection system, the WWTP would detect the presence of the material by way of nitrate monitoring which is done every four hours with a field nitrate kit.

2. Upon detecting nitrate, the WWTP operators would shut off the effluent and route the influent to the new influent/effluent storage tanks which have the capacity to collect influent for at least two days.

3. WWTP effluent would be configured for retention in the new effluent storage tanks.

4. All terminal pond discharges would be shut off.

5. All transfers of pond water from A-3 or B-5 would be shut off.

6. Samples would be collected from the WWTP influent and one or more of the following ponds: Pond A-3, Pond A-4, or Pond B-5, for gross alpha and gross beta analysis.

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7. If gross alpha/beta samples detect elevated activity, samples for isotopic analysis would be collected and analyzed. If activity levels are not elevated, then samples for metals analysis would be collected.

8. The nature and source of the nitrate containing material would be identified and controlled.

9. Water from the new influent / effluent storage tanks would be pumped to an evaporative treatment facility (e.g. Building 774 or Building 910).

10. Pond water would be sampled and analyzed for constituents of concern to determine appropriate action for treatment, transfer, detention, or discharge of the pond water.

In order to determine the effects of the release to the WWTP, a model outlined by Thomann and Mueller was used to describe the attenuation and treatment of the plutonium nitrate in the WWTP. The details of the unit process modeling are described below.

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3.8.1 Modeling the Impact of a Hypothetical Slug Release on the RFETS WWTP

The model developed here evaluates the impact of a slug release oPuNO3 on the Rocky Flats Enviornmental Technology Site's wastewater treatment plant. The model is based on a series of lakes model describe in Thomann and Mueller, expanded to accommodate all of the unit processes at the WWTP.

Determine the concentration of PuNO3 in the equalization basin upon release of initial amount. 146 liters containing 140 grams/l of PuNO3 is released from B771.

Flow $Q := 140$ gallons per minute

Load $w := 42.5$ lbs. Plutonium nitrate Basin Volume $Veb := 30000$ gallons

Caculate the concentration, C, of the the initial release into the EQ basin:

$$C := \frac{w}{Veb \cdot 8.34} \qquad C = 1.698641 \cdot 10^{-4}$$

Now, show the concentration of PuNO3 in the basin over time, t.

Range of time,i, in hours $i := 0..24$

First, calculate the retention time, td, of the basins:

$$td_1 := \frac{Veb}{Q} \qquad td_1 = 214.286$$

Define: $\alpha_1 := \frac{1}{td_1}$ $\qquad \alpha_1 = 0.005 \text{ min}^{-1}$

and determine the concentration, s, using

$$s_i := C \cdot e^{(-\alpha_1 \cdot i \cdot 60)} \cdot 10^6 \text{ ppm}$$

Therefore, at time t = 1 hour (i = 1), the concentration is

$$s_1 = 128.381 \text{ ppm}$$

Now calculate the addition of a second basin, the primary clarifier:

$$Vpri := 12766 \qquad td_2 := \frac{Vpri}{Q} \qquad td_2 = 91.186 \text{ min.}$$

$$\alpha_2 := \frac{1}{td_2} \qquad \alpha_2 = 0.011 \text{ min}^{-1}$$

$$sp_i := \alpha_2 \cdot C \cdot \left[\frac{e^{(-\alpha_1 \cdot i \cdot 60)}}{(\alpha_2 - \alpha_1)} + \frac{e^{(-\alpha_2 \cdot i \cdot 60)}}{(\alpha_1 - \alpha_2)} \right] \cdot 10^6 \text{ ppm}$$

Thus, at time t = 1 hour, the concentration in the primary clarifier is:

$sp_1 = 70.344$ ppm

The next Unit Process is the Aeration Basin, where

$$Vab := 65450 \qquad td_3 := \frac{Vab}{Q}$$

$td_3 = 467.5$ min.

The aeration basin provides biological treatment and allows for interaction of non-biodegradable material with biosolids. Heavy metals show an affinity for the biosolids and generally partition with the sludge. At least 80 % of most metals remain with the solids in the aeration basin or clarifiers. The partition factor represents the amount of material flowing in the wastewater to the next unit process.

$p := .2$ Partition factor

$$\alpha_3 := \frac{1}{td_3} \qquad \alpha_3 = 0.002 \quad \text{min}^{-1}$$

And the concentration of PuNO3 in the aeration basin is:

$$sab_i := \alpha_2 \cdot \alpha_3 \cdot C \cdot p \cdot \left[\frac{e^{(-\alpha_1 \cdot i \cdot 60)}}{(\alpha_2 - \alpha_1)\cdot(\alpha_3 - \alpha_1)} + \frac{e^{(-\alpha_2 \cdot i \cdot 60)}}{(\alpha_1 - \alpha_2)\cdot(\alpha_3 - \alpha_2)} + \frac{e^{(-\alpha_3 \cdot i \cdot 60)}}{(\alpha_1 - \alpha_3)\cdot(\alpha_2 - \alpha_3)} \right] \cdot 10^6$$

The next step after the aeration basin is the Secondary Clarifier:

$Vsec := 53235$ gallons

$$td_4 := \frac{Vsec}{Q}$$

$$\alpha_4 := \frac{1}{td_4} \qquad \alpha_4 = 0.003 \ \text{min}^{-1}$$

$$ssec_i := \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot p \cdot C \cdot \left[\frac{e^{(-\alpha_1 \cdot i \cdot 60)}}{(\alpha_2 - \alpha_1)\cdot(\alpha_3 - \alpha_1)\cdot(\alpha_4 - \alpha_1)} + \frac{e^{(-\alpha_2 \cdot i \cdot 60)}}{(\alpha_1 - \alpha_2)\cdot(\alpha_3 - \alpha_2)\cdot(\alpha_4 - \alpha_2)} + \frac{e^{(-\alpha_3 \cdot i \cdot 60)}}{(\alpha_1 - \alpha_3)\cdot(\alpha_2 - \alpha_3)\cdot(\alpha_4 - \alpha_3)} + \frac{e^{(-\alpha_4 \cdot i \cdot 60)}}{(\alpha_1 - \alpha_4)\cdot(\alpha_2 - \alpha_4)\cdot(\alpha_3 - \alpha_4)} \right] \cdot 10^6$$

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The final step in the treatment process is the tertiary clarifier. This step is followed by the chlorine contact chamber, but that volume is considered negligible (3000 gallons) compared to the unit processes.

$$Vter := 76284\ \text{gallons} \qquad td_5 := \frac{Vter}{Q}\ \text{min.}$$

$$\alpha_5 := \frac{1}{td_5}\ \text{min}^{-1} \qquad \alpha_5 = 0.002\ \text{min}^{-1}$$

$$ster_i := \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot p \cdot C \cdot \left[\frac{e^{(-\alpha_1 \cdot i \cdot 60)}}{(\alpha_2-\alpha_1)\cdot(\alpha_3-\alpha_1)\cdot(\alpha_4-\alpha_1)\cdot(\alpha_5-\alpha_1)} + \frac{e^{(-\alpha_2 \cdot i \cdot 60)}}{(\alpha_1-\alpha_2)\cdot(\alpha_3-\alpha_2)\cdot(\alpha_4-\alpha_2)\cdot(\alpha_5-\alpha_2)} + \frac{e^{(-\alpha_3 \cdot i \cdot 60)}}{(\alpha_1-\alpha_3)\cdot(\alpha_2-\alpha_3)\cdot(\alpha_4-\alpha_3)\cdot(\alpha_5-\alpha_3)} + \frac{e^{(-\alpha_4 \cdot i \cdot 60)}}{(\alpha_1-\alpha_4)\cdot(\alpha_2-\alpha_4)\cdot(\alpha_3-\alpha_4)\cdot(\alpha_5-\alpha_4)} + \frac{e^{(-\alpha_5 \cdot i \cdot 60)}}{(\alpha_1-\alpha_5)\cdot(\alpha_2-\alpha_5)\cdot(\alpha_3-\alpha_5)\cdot(\alpha_4-\alpha_5)} \right] \cdot 10^6$$

Summary of the concentrations over time, i, from 0 to 24 hours:

i	s_i	sp_i	sab_i	$ssec_i$	$ster_i$
0	169.864	0	$5.798\cdot 10^{-15}$	$-3.123\cdot 10^{-14}$	$1.174\cdot 10^{-13}$
1	128.381	70.344	1.012	0.056	0.002
2	97.028	89.595	2.887	0.333	0.02
3	73.332	86.581	4.688	0.844	0.078
4	55.423	75.207	6.077	1.515	0.192
5	41.888	61.901	6.993	2.255	0.369
6	31.658	49.404	7.485	2.989	0.605
7	23.927	38.696	7.638	3.66	0.89
8	18.083	29.949	7.539	4.236	1.21
9	13.667	22.999	7.264	4.699	1.551
10	10.329	17.571	6.873	5.045	1.899
11	7.807	13.377	6.415	5.278	2.24
12	5.9	10.161	5.923	5.408	2.565
13	4.459	7.706	5.423	5.445	2.864
14	3.37	5.837	4.931	5.405	3.132
15	2.547	4.419	4.46	5.3	3.364
16	1.925	3.343	4.015	5.144	3.558
17	1.455	2.529	3.602	4.948	3.713
18	1.1	1.912	3.221	4.722	3.83
19	0.831	1.446	2.873	4.477	3.91
20	0.628	1.093	2.557	4.219	3.956
21	0.475	0.826	2.272	3.954	3.969
22	0.359	0.624	2.016	3.689	3.953
23	0.271	0.472	1.786	3.427	3.912
24	0.205	0.357	1.581	3.172	3.848

These values can be plotted to graphically show the time variation of concentration.

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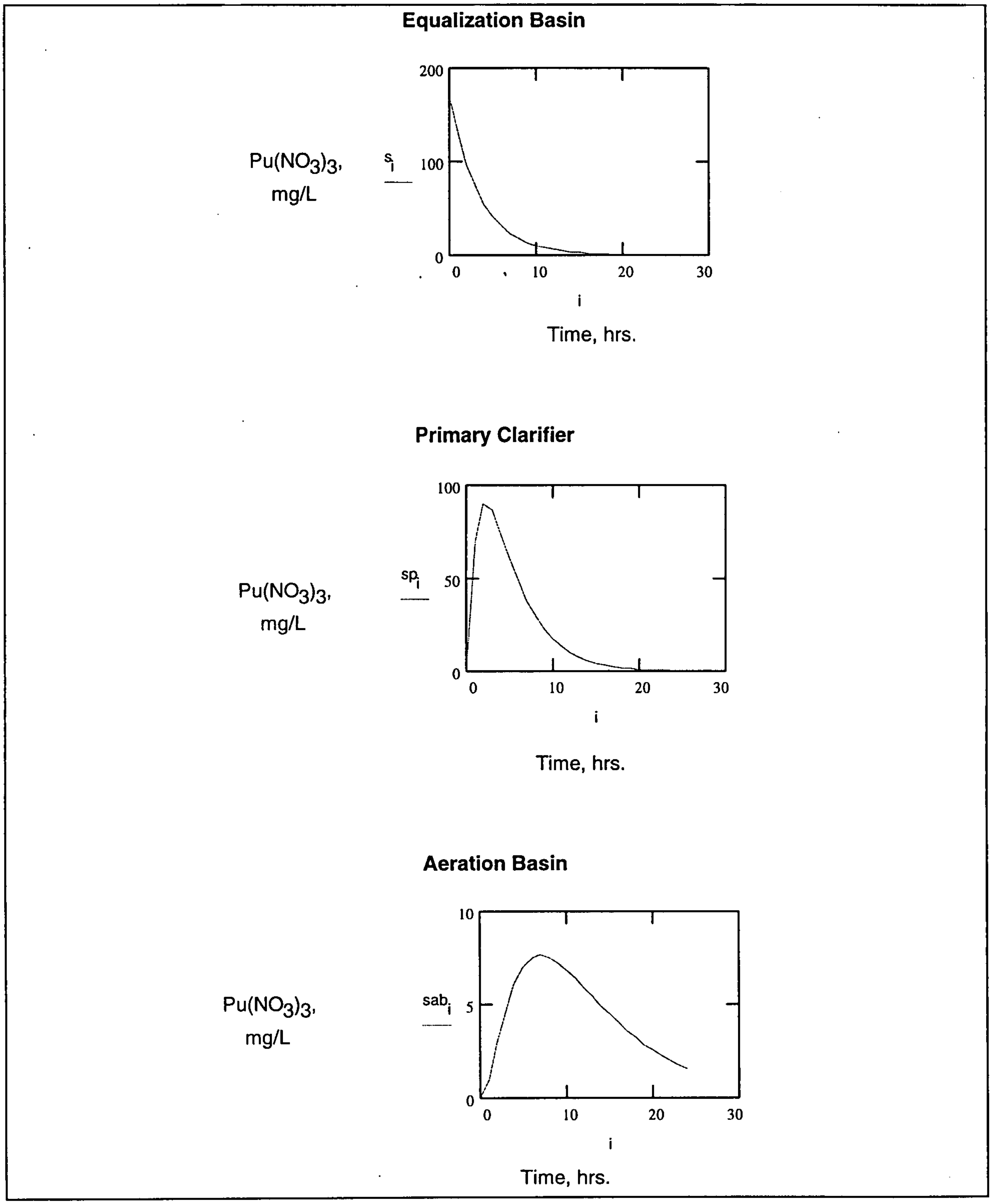

Figure 3-3. Time Variation of PuNO3 Concentration in the WWTP Unit Processes for Radionuclide Solution Release Scenario to the RFETS Sanitary System.

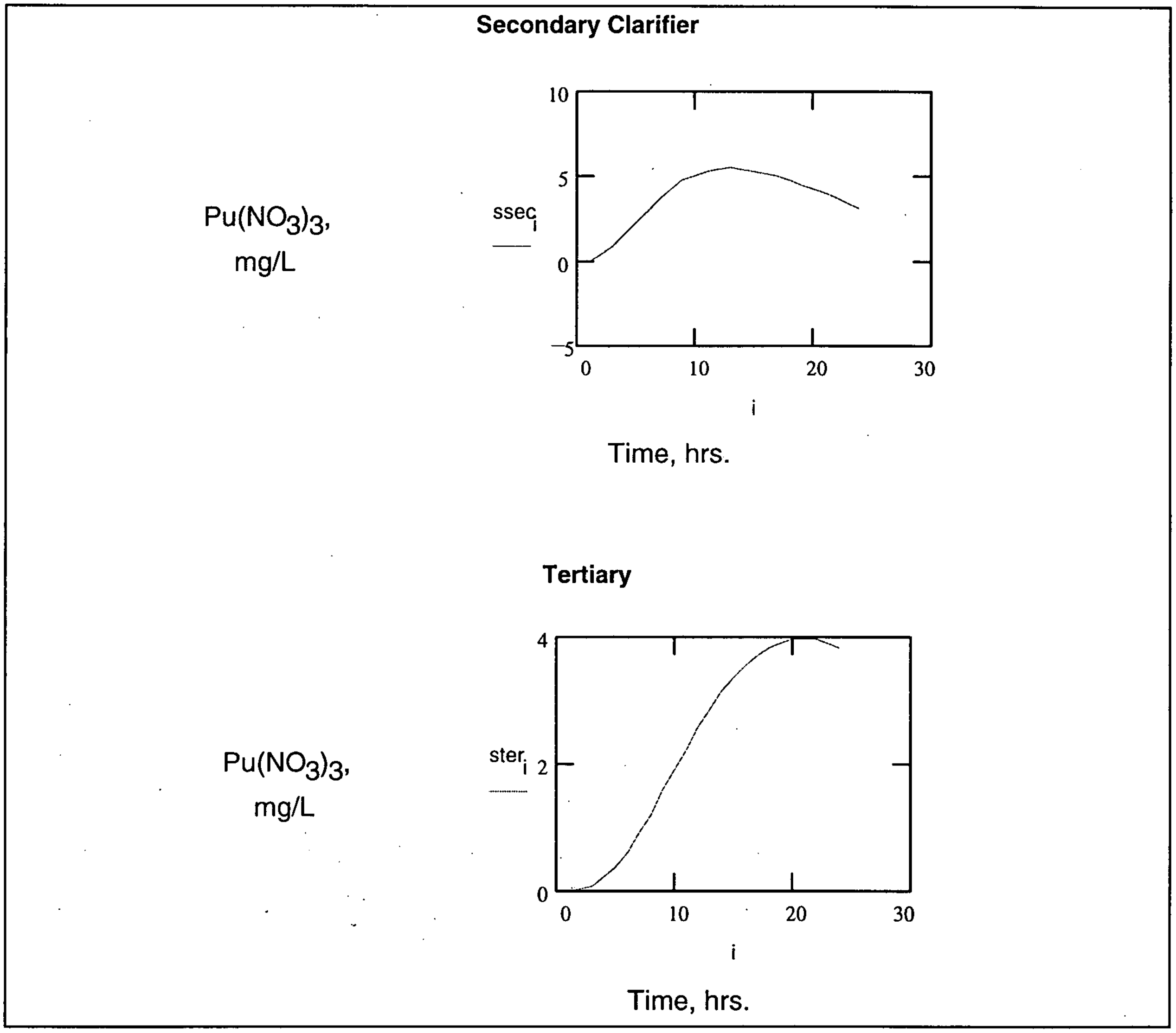

Figure 3-3. Time Variation of PuNO3 Concentration in the WWTP Unit Processes for Radionuclide Solution Release Scenario to the RFETS Sanitary System. (continued)

Figure 3-3 shows that at four hours after the release to the sanitary sewer, the concentration of plutonium nitrate in the WWTP effluent would reach about 0.25 mg/L (1.4 µCi/L). Assuming a typical WWTP discharge rate of 0.24 cfs (6.7 Liters / second), the total estimated mass of plutonium discharged to the detention ponds would be 1.9 grams after 4 hours. If it is further assumed that if the WWTP was discharging to Pond A-3 for four hours prior to detection in the WWTP, and Pond A-3 is at 80% capacity, then the estimated concentration of plutonium in Pond A-3 would be about 0.004 µCi/L. On the other hand, if the WWTP was discharging to Pond B-5, and the Pond was at 60% capacity, then the estimated concentration of plutonium in Pond B-5 would be about 0.002 µCi/L. The above scenario depicts a worst case example of a hypothetical catastrophic radiological liquid release to the WWTP which is very unlikely.

4. IDENTIFICATION OF CONTAMINATED RUNOFF SOURCE AREAS

A comprehensive stormwater management and pond management program is conducted by the Site and covers identification and control of contaminated runoff sources. The identification of the contaminated runoff sources is a continuing Site activity through implementation of RFCA Industrial Area surface-water performance monitoring program and coordination with other Site investigation activities, including OU investigations.

4.1 DATA SOURCES AND PREVIOUS INVESTIGATIONS

The following data and information resources were used to evaluate potential runoff contamination sources at the Site:

- Historical Release Report
- OU12 sediment-quality data
- OU12 soil sampling data
- High Purity Germanium (HPGe) Survey
- Surface water monitoring data
- Industrial Area field inspection information

A brief description of these information resources is contained is Sections 4.1.1 through 4.1.6.

4.1.1 Historical Release Report

The Historical Release Report provides a listing of all known spills, releases, and incidents involving hazardous substances occurring since the Rocky Flats Plant was opened in 1951. Information was compiled through file review, interviews, site inspections and photographs. For each spill or release event, documentation provides a physical and chemical description of the constituents released, responses to the events, and the fate of the constituents released to the environment if known.

This report was used to identify which Individual Hazardous Substance Sites (IHSSs) are potential contributors of plutonium and americium-contaminated runoff based on the history of release events.) to assist in field inspection of these IHSSs. The plutonium-239,240 (Pu)-related IHSSs were mapped (Plate 1 to assist in field inspection of potential source areas.

4.1.2 OU12 Sediment Quality Data

From February through April of 1994, OU12 Phase I RCRA Facility Investigation (RFI) field activities culminated in a synoptic, or snapshot in time, sampling project for the industrial area stormwater conveyance structures. Fine-grained materials were preferentially sampled from the ditches in order to maximize detection of the transuranic radioisotopes. The ditches were sampled at ditch confluences as well as spatially between confluences to determine source areas of contamination and are shown in Plate 2a and Plate 2b (EG&G, 1995).

Americium-241 (Am) and Pu activities in the ditch bottom sediments are mapped in Plates 2a and 2b. The mapped data indicate that much of the Site ditch sediments were measured to have less than 0.1 pCi/gram of Pu and Am. However, the data also show that many of the ditches that drain the 700 and 800 Areas were found to have sediments measured at activities greater than 0.1 pCi/gram of Pu and Am. The highest Pu and Am activities are north and east of the Solar Evaporation Ponds and south by southeast of Buildings 771 and 774.

4.1.3 OU12 Soil Sampling Data

Industrial Area soil samples, collected to satisfy OU8, OU9, OU10, OU12, OU13, and OU14 Phase I Remedial Investigation / RFI data quality objectives, are mapped in Plate 4a and Plate 4b. These data show the areal distribution of Pu and Am activities in the soil sediments.

4.1.4 High Purity Germanium (HPGe) Survey

In 1993 and 1994, Industrial Area Operable Units were surveyed by gamma spectroscopy instrumentation using High Purity Germanium (HPGe) detector(s). EG&G personnel used the HPGe instrumentation to measure Am-241 activities in IA surficial materials. The gamma spectroscopy (HPGe) data are of limited utility due to the large radius of investigation (about 30 feet) used for the measurements. This radius of investigation created the potential for the detector(s) to measure activity emitted from production buildings (also known as "shine") and also to miss smaller, localized sources. Bearing these factors in mind, the data were mapped and contoured to create the map in Plate 4. This map indicates that transuranic contamination may be present in the vicinity of building 664, 661, 707, 713/713A, 964, the 904 pad (S. side), and the T891 yard.

Activity detected around Buildings 664, 569 and the 904 pad is suspected to be mostly "shine" from waste stored in these buildings. Nonetheless, these areas were intensely scrutinized during the field inspection activity to evaluate their potential as runoff contaminant sources.

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4.1.5 Surface Water Monitoring Data

Data from the Industrial Area surface water verification monitoring program were evaluated to identify potential radionuclide source areas. Automated stations are used to measure flow quantity and collect runoff samples from IA drainage areas. The monitoring strategy uses a two-tiered approach; Tier I stations monitor runoff at the IA perimeter and Tier II stations monitor drainage areas near specific Transition activities.

- Tier 1 monitoring consists of continuously recording, automated, stream gaging stations which monitor all surface-water leaving the perimeter of the IA. There are ten (11) Tier I stations originally established for the IA IM/IRA.

- Tier II monitoring consists of sub-basin gaging stations in and around Transition areas to provide a high resolution of monitoring for potential releases of materials from those areas. Two (2) Tier II stations are located near Building 889, and two (2) additional Tier II stations are located near the 200 Area Fuel Oil tanks.

4.1.6 Industrial Area Field Inspections

Using the in-situ gamma spectroscopy screening data, soil and sediment data, plutonium-related IHSS information, and with knowledge of surface water monitoring results from different drainage basins, a team of RMRS personnel inspected Industrial Area drainages to identify sources and pathways for transmitting contaminated runoff to the A-, B-, and C-series detention ponds. Inspection of the drainage basins upstream of the A- and B-Series Ponds was conducted in October 1995. Inspection of the SID/C-Series Pond drainage was conducted in December 1995. The team looked for physical features with the following characteristics:

- Erosion on IHSSs,

- Areas of concentrated fine sediments in storm drainage pathways

- Areas which contribute large quantities of runoff (e.g., steep dirt roads, barren hillsides, roof drains, paved areas, and slopes needing revegetation,

- Position of IHSSs in relation to stormwater drainage pathways, and

- Overall condition of storm drainage pathways.

An additional field inspection was conducted with personnel from the Site and CDPHE in May 1996 and, since then, other follow-up inspections have been performed by Site personnel. Potential source areas

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were identified from the inspection results, and these areas are mapped on Plate 1. Field inspection results and source control recommendations are contained in Section 5.

5. WATERSHED IMPROVEMENTS AND SOURCE CONTROL

5.1 RATIONALE FOR IMPLEMENTATION

Studies have been conducted indicating that, when sources are available, radionuclides may associate with solids suspended in stormwater (TA reference Section 6). Stormwater data collected at the Site between 1991 and 1995 supports this conclusion (TA reference Section 6). Based on these characteristics of radionuclides and stormwater, it follows that removing particulate material from stormwater runoff should remove radionuclide loading from the water.

In order to minimize the amount of radionuclides being carried from the Site by runoff, a system of controls are being implemented to stabilize sediment material and entrap particulate matter suspended in stormwater. Locations for these improvements were determined based on information gathered from the resources described in Section 4.

Implementation of watershed control measures is a Best Management Practice (BMP) in support of meeting RFCA water quality standards. The RFCA Points of Compliance for surface water are located at the terminal pond outfalls. Instituting watershed improvements as outlined in this section represents an effort to capture radionuclide loads closer to the source, upstream from the ponds and further from the Points of Compliance.

5.2 POTENTIAL SIGNIFICANT SOURCE LOCATIONS

This Section identifies, by drainage, those Site locations determined to be the most likely source areas for radionuclides in stormwater runoff. For each individual area, background information is noted that supports the indication the area could be a potential source of radionuclides. Remedial actions for each location are identified as being either already completed or recommended for future implementation.

5.2.1 Woman Creek Contaminated Runoff Sources

<u>903 Pad Lip Area</u>

A. Background and Source Identification

History and Radiological IHSSs - Storage of waste drums in the 903 Pad area began in 1958 and the first leaking drum was identified in 1959. By mid 1962, an area 5 feet by 25 feet had an activity of 100,000 cpm. There were approximately 1,500 drums stored there, with an estimated 50 to 60 percent of the drums badly corroded. In August 1967, heavy rains resulted in the spread of plutonium contamination from the waste oil drums in the 903 area. Transfer of contaminated oil from the storage area was completed in May of

1968 - approximately 50 of the drums were found to be empty, the contents having leaked entirely. It has been estimated that approximately 150 grams of plutonium leaked into the soil with approximately 23 grams covered by the asphalt pad.

Stormwater Sampling Information - Stormwater samples collected in the 903 pad lip area during the May 1995 storm event ranged from 2.98 to 247.5 pCi/L for Pu and from 0.45 to 48.07 pCi/L for Am (RMRS, 1995b). Gaging station SW027, located downstream from the 903 Pad area in the SID, has recorded average activities of 0.31 pCi/l Pu and 0.118 pCi/L Am (Squibb, 1996e)[a]. The RFCA Action Level at SW027 is 0.15 pCi/L for Pu and Am.

Soil Survey Information - Generally the highest activities measured in soil at the Site are found to the south/southeast of the 903 Pad, measuring up to 2897 pCi/g Pu just to the east of the road that runs down to Pond C-1.

Field Inspection Information - A small dirt road coming down hill in the 903 Pad lip area provides a direct route for runoff over the inner security fence road and onto the road that goes down to Pond C-1. The culvert on the uphill side of the inner road is plugged, also causing flows to go through the fence and on to the road running downhill to Pond C-1.

B. Remedial Actions

Completed

- The buffer zone road leading down the hill from the 903 Pad to Pond C-1 was closed and revegetated using imported topsoil, native grass seed mix, and a SoilGuard® protective cover (approximately 1900 square yards - September 1996).

- Silt fences were installed in the major drainage swales leading from the 903 Pad Lip Area into the S.I.D. (approximately 300 linear feet of fence in selected locations - June 1996).

Recommended

- Apply TopSeal® road sealant to dirt road on north side of security fence below the 903 Pad (planned for late September 1996).

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[a] Average activities are based on 4 storm-water samples collected at station SW027 between 5/23/95 and 6/28/95.

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- Remove trees from South Interceptor Ditch to improve capacity for handling runoff from south side of Industrial Area, including the 903 Pad Lip Area (planned for late September 1996).

- Repair/replace culvert on dirt road north of security fence to enhance proper drainage of the hillside.

5.2.2 South Walnut Creek Contaminated Runoff Sources

903/904 Pads North Side

A. Background and Source Identification

History and Radiological IHSSs - See text above in Woman Creek section for the 903 Pad. IHSSs 112 and 155 encompass the 903 Pad, and IHSS 213 encompasses the 904 Pad.

Stormwater Sampling Information - There is not currently a gaging station that collects samples specifically from the 903/904 Pad area. Gaging station SW022 collects water from the south-central portion of the Industrial Area, and includes runoff from the 904 Pad and the northern half of the 903 Pad. Average activities from samples collected at SW022 are 0.187 pCi/L Pu and 0.084 Am (Squibb, 1996c)[b]. The maximum Pu activity measured here was 0.698 pCi/L.

HPGe Survey Information - The 904 Pad is one of the areas at the Site with the highest measured gamma activity (the 903 Pad area was not included in this survey). Measurements were recorded of approximately 9 to 50 pCi/g.

Soil Survey Information - The 903 Pad area is where some of the highest soil activities at the Site were measured (120 pCi/g Pu).

Field Inspection Information - Evidence of runoff erosion and sediment deposition exists in the northwest corner of the ditch that drains the 903 Pad area, indicating that 903 Pad runoff is a potential source of contaminated fine material which could impact stormwater runoff quality.

[b] Average activities are based on 5 storm-water samples collected at station SW022 between 5/22/95 and 10/22/95.

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B. Remedial Actions

Completed

- The road that runs north-south between the 903 and 904 Pads was sealed with TopSeal® road sealant (approximately 2500 square yards - August 1996).

Recommended

- Re-vegetate small areas in ditches along road between the 903 and 904 Pads to minimize sediment transport.
- Install silt fences downstream on northwest corner of 903 Pad to minimize sediment transport.

Building 884

A. Background and Source Identification

History and Radiological IHSSs - IHSS 164.3 is located along the west side of Building 884, and is the result of two separate incidents involving potentially uranium-contaminated waste releases from drums stored outside of the building. IHSS 164.3 is listed as ER Risk Prioritization number 36.

Stormwater Sampling Information - The Industrial Area IM/IRA surface water monitoring program identified contaminated runoff at gaging station GS27, located in the stormwater drainage gutter from the Building 889 and 884 area. Average activities in the stormwater at GS27 were measured at 26.17 pCi/L for Pu and 12.65 for Am (Squibb, 1996d)[c].

Sediment Survey Information - Sediments in the 800 Area were found to have Pu activities ranging from 0.18 to 0.23 pCi/g. Sediment sampled downstream from the confluence of the known Building 884 contaminated runoff with Central Avenue Ditch only contained 0.018 pCi/g Pu, indicating that the Pu in the runoff is either being diluted in the Central Avenue Ditch samples, or efficiently transported in the ditch to the detention ponds.

[c] Average activities are based on 4 storm-water samples collected at station GS27 between 5/23/95 and 11/27/95.

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Field Inspection Information - A large portion of the land surrounding Building 884 is exposed dirt. Worsening the situation, much of the paved area has large amounts of sediment deposition, especially against the south side of Building 884.

B. Remedial Actions

Completed

- Removed and drummed sediments deposited along south side of Building 884 (7 drums - August 1996).

Recommended

- Apply TopSeal® soil sealant on dirt area south of Building 884 to minimize sediment transport (planned for late September 1996).
- Install silt fences in minor drainage paths downstream from Building 884 (planned for late September 1996).

Central Avenue Drainage Ditch

A. Background and Source Identification

History and Radiological IHSSs - The Central Avenue Ditch receives runoff from the central portion of the Industrial Area and therefore indirectly collects flow coming from several IHSSs. These include IHSS 157.2, surrounding Building 444, which resulted from a series at least six separate uranium releases since 1953. IHSS 160 covers an area, currently the Building 444 parking lot, that was previously used for waste storage and where punctured or leaking waste drums and boxes released uranium and plutonium contaminants.

Stormwater Sampling Information - Gaging station SW022 is located at the eastern end of the Central Avenue Ditch near the east inner gate entrance. Average activities from samples collected at SW022 are 0.187 pCi/L Pu and 0.084 Am. The maximum Pu activity measured here was 0.698 pCi/L.

Sediment Survey Information - Sediments in the Central Avenue Ditch upstream from gaging station SW022 were found to have a Pu activity of 0.340 pCi/g, which corresponds with the order of magnitude found in many of the sediments in the 700 Area.

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Field Inspection Information - The capacity of this drainage ditch has been significantly reduced because of sediment deposition. Several of the culverts are clogged by sediments or otherwise damaged.

B. Remedial Actions

Recommended

- The ditch needs to be cleared to remove any potentially contaminated sediments, increase its capacity, and redefine the channel. Culvert crossings need to be cleared and/or repaired. Providing outlet controls for these culverts would reduce erosion and enhance settling.

Building 707 - East Side

A. Background and Source Identification

History and Radiological IHSSs - IHSS 194, within Building 707, resulted from a steam condensate leak inside the building. The condensate contained tritium at approximately 1000 pCi/l. The leak exited the east side of the building in the area where roof drains are causing erosion on the east side of Building 707. This IHSS does not appear on the ER Risk Prioritization list. This area has recently been remediated because of past PCB contamination.

Stormwater Sampling Information - Stormwater data from gaging station GS10, which measures runoff from the central Industrial Area, averaged 0.210 pCi/L Pu and 0.198 pCi/L Am. The RFCA Action Level at this station is 0.15 pCi/L for Pu and Am.

Field Inspection Information - There are several large downspouts on the east side of Building 707 which convey runoff from the building roof and direct it to storm drains along the roadway east of the building. Significant erosion is occurring at the points of discharge, transporting sediments into the storm drains.

B. Remedial Actions

Completed

- Applied native seed mix and SoilGuard® cover to dirt area exposed by PCB removal activities (approximately 200 square yards - June 1996).

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Recommended

- Install concrete splash blocks under roof drain outlets and line drainage channels from roof drains with rock to minimize erosion (planned for late September 1996).

Building 707 - West Side

A. Background and Source Identification

History and Radiological IHSSs - This area encompasses several radiological IHSSs, including 159, 150.5, 123.2, and 150.2. IHSS 159 is listed as ER Risk Prioritization number 41. A likely cause for the high gamma readings, and the cause of three of the IHSSs, are past leaks in the underground process waste system which runs through this area.

Stormwater Sampling Information - Stormwater data from gaging station GS10, which measures runoff from the central Industrial Area, averaged 0.210 pCi/L Pu and 0.198 pCi/L Am (Squibb, 1996a)[d]. The RFCA Action Level at this station is 0.15 pCi/L for Pu and Am.

HPGe Survey Information - The gamma spectroscopy data shows the area between Buildings 707 and 564 (West of 707) to be one of the areas of highest gamma activity (indication of Am-241) at the Site.

Field Inspection Information - This area drains primarily into three storm drains - one at the southwest corner of Building 707, one at the northwest corner of Building 708, and one in the center of the roadway east of Building 564. The majority of the area is bare, unvegetated earth. There are significant depositions of sediments around both storm drains near Buildings 707 and 708. There are also signs of sediments being transported from the storage area to the storm drain in the roadway east of Building 564.

B. Remedial Actions

Completed

- Applied native seed mix and SoilGuard® cover to exposed dirt area on west side of Building 707 (approximately 3200 square yards - June 1996).

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[d] Pu average activities are based on 45 storm-water samples collected at station GS10 between 3/15/91 and 10/22/95; Am average activities are based on 41 storm-water samples collected at station GS10 between 3/31/92 and 10/22/95.

Recommended

- Install silt fences or hay bales to filter runoff before it enters the 2 storm drains on west side of Building 707 (planned for September 1996).

5.2.3 North Walnut Creek Contaminated Runoff Sources

Building 771 Annex - South Side

A. Background and Source Identification

History and Radiological IHSSs - IHSS number 150.3 is on the south side of the Building 771 Annex (building connecting 771 and 774). IHSS 150.3 is ranked 27th on the Environmental Restoration (ER) Risk Prioritization list. This IHSS is located on an extremely steep slope that was stabilized many years ago by covering the hill with a steel mesh and spraying synthetic foam on the mesh to a depth of about three to four inches. Over time, the foam has been weathered, and weeds have grown through the deteriorated foam to reveal some exposed soil material.

Stormwater Sampling Information - Stormwater data from gaging station SW093, which measures runoff from the northern Industrial Area, averaged 0.603 pCi/L Pu and 0.297 pCi/L Am (Squibb, 1996b)[e]. The RFCA Action Level at this station is 0.15 pCi/L for Pu and Am.

Sediment Survey Information - No sediment samples were collected at this particular location, however, the sediment samples collected immediately to the southeast had some of the highest activities at the Site (0.80 pCi/g Pu and 0.99 pCi/g Am).

Field Inspection Information - The hill drains directly to two storm drain drop boxes located in the courtyard south of the 771 Annex. All runoff flows down the hill, over IHSS 150.3 and into the storm drains.

[e] Average activities are based on 22 storm-water samples collected at station SW093 between 3/14/91 and 6/28/95.

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B. Remedial Actions

Recommended

- Install silt fences or hay bales to filter runoff before it enters storm drains at foot of hill (planned for September 1996).

- Install asphalt berm on road south of 771 and re-grade surrounding ditches as necessary to divert runoff before it reaches eroded hillside.

Building 774 - East Hillside

A. Background and Source Identification

History and Radiological IHSSs - Runoff from the area around Solar Pond 207C is routed down a steep dirt road east of Building 774 before entering the drainage leading to gaging station SW093. A large portion of this runoff originates from IHSSs 124, 125, 149, and 163.1, all of which have or had plutonium contamination in surficial materials. These materials remain as results of past spills and other releases of plutonium-containing materials outside Building 774. IHSS 163.1 is ranked 37th on the ER Risk Prioritization list.

Stormwater Sampling Information - Stormwater data from gaging station SW093, which measures runoff from the northern Industrial Area, averaged 0.603 pCi/L Pu and 0.297 pCi/L Am. The RFCA Action Level at this station is 0.15 pCi/L for Pu and Am.

HPGe Survey Information - The road drains an area west of Solar Pond 207C where a measurement of approximately 13 pCi/g was taken (roughly one order of magnitude higher than the surrounding area).

Sediment Survey Information - Measurements of activities in sediments in the area drained by the road are amongst the highest recorded at the Site (0.800 pCi/g Pu and 0.990 pCi/g Am). Activities measured in sediments at the bottom of the hill are also high (0.650 pCi/g Pu and 0.190 pCi/g Am).

History and Radiological IHSSs - Runoff from the area around Solar Pond 207C is routed down a steep dirt road east of Building 774 before entering the drainage leading to gaging station SW093. A large portion of this runoff originates from IHSSs 124, 125, 149, and 163.1, all of which have or had plutonium contamination in surficial materials. These materials remain as results of past spills and other releases of plutonium-containing

materials outside Building 774. IHSS 163.1 is ranked 37th on the ER Risk Prioritization list.

Stormwater Sampling Information - Stormwater data from gaging station SW093, which measures runoff from the northern Industrial Area, averaged 0.603 pCi/L Pu and 0.297 pCi/L Am. The RFCA Action Level at this station is 0.15 pCi/L for Pu and Am.

HPGe Survey Information - The road drains an area west of Solar Pond 207C where a measurement of approximately 13 pCi/g was taken (roughly one order of magnitude higher than the surrounding area).

Sediment Survey Information - Measurements of activities in sediments in the area drained by the road are amongst the highest recorded at the Site (0.800 pCi/g Pu and 0.990 pCi/g Am). Activities measured in sediments at the bottom of the hill are also high (0.650 pCi/g Pu and 0.190 pCi/g Am).

Field Inspection Information - Field inspection confirmed the presence of fine sediment material deposited on the road and in the drainage ditch along the road.

B. Remedial Actions

Completed

- TopSeal® road sealant was applied to the dirt road running downhill from Solar Pond 207C (east of Building 774)(approximately 2500 square yards - August 1996).

Recommended

- Install silt fence or hay bales at foot of road to filter sediments prior to entering drainage ditch.

Building 779 - East Side

A. Background and Source Identification

History and Radiological IHSSs - Runoff from the east side of Building 779 is routed to a drainage drop box located about 50 feet north of Building 782 which directs the flow through a culvert that ultimately discharges to gaging station SW093. A portion of this runoff passes through IHSSs 150.6 and 150.8, both of which relate to improper storage/handling of waste containers prior to 1973.

Stormwater Sampling Information - Stormwater data from gaging station SW093, which measures runoff from the northern Industrial Area, averaged 0.603 pCi/L Pu and 0.297 pCi/L Am. The RFCA Action Level at this station is 0.15 pCi/L for Pu and Am.

Soil Survey Information - Pu activity in the soil east of 779 was measured at approximately 15 pCi/g. This is one order of magnitude higher than measurements taken in the surrounding area.

Field Inspection Information - Street gutters east of Building 779 were found to contain fine sediments. It is hypothesized that the fine sediments accumulating in these storm gutters contain adsorped actinides, and this material is flushed to North Walnut Creek (gaging station SW093) during storm events.

B. Remedial Actions

Completed

- Applied native seed mix and SoilGuard® cover to exposed dirt area on east side of Building 779 (approximately 800 square yards - June 1996).

Recommended

- Install silt fences or hay bales to filter runoff before it enters storm drain (planned for September 1996).

5.3 MAINTENANCE PROGRAMS

Many of the watershed improvements already completed or recommended require some maintenance. Accumulated sediments must be removed from silt fences and ditches must be periodically cleared of vegetation and sediments. In addition, routine street sweeping to collect and remove particulates, specifically due to sand and gravel application during winter months, can significantly reduce the sediment load entering drainage ditches. As is the case with the recommended future watershed improvements, ongoing maintenance of watershed improvement structures is subject to DOE budget constraints.

Plate 1. Radionuclide Related IHSS Locations, Drainage Pathways, and Potential Plutonium Surface Areas

Plate 2a. Areal Distribution of Pu Activity in Industrial Area Sediments

Plate 3b. Areal Distribution of Am Activity in Industrial Area Sediments

Plate 4. Integrated OU HPGe Results for Am

Plate 5a. Areal Distribution of Pu Activity in Surface Soils

Plate 6b. Areal Distribution of Am Activity in Surface Soils

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6. RADIONUCLIDE REMOVAL ANALYSIS

This section develops a decision support tool for operating the Site detention ponds in a controlled detention manner. The tool will incorporate a spreadsheet based model. This model is not a model in the familiar sense of the word; it contains no complex code, but simply uses computer spreadsheet to automate the calculation of a series of standard theoretical equations. In the following sections, a model is defined as a collection of mathematical expressions used to describe a system while attempting to account for all the known properties of that system. A description of the model follows:

- The controlled detention model determines stormwater inflow rates above which constituent loadings to the ponds are sufficiently high and settling times are short enough such that the Proposed Basic Standard, a site-specific water-quality goal, is expected to be exceeded at the detention pond outlets. When the specified inflow rate is exceeded, controlled detention operation will be terminated and stormwater will be detained in the detention ponds to allow for batch-mode settling.

The numerical results presented in this section are based on the current detention pond system parameters at the Site. These parameters include but are not limited to current environmental data, hydrologic / hydraulic conditions, water-quality goals and standards, regulatory issues, funding issues, and constituent loads. It is expected that this document will be a dynamic document. Changes in pond operations may occur in accordance with changes in hydraulic conditions.

6.1 BASIC MODEL FOUNDATIONS

6.1.1 Behavior of RFETS Detention Ponds as Sedimentation Basins

Stormwater runoff from the IA is captured by the system of detention ponds located in the Site buffer zone. Each pond, acting as an individual sedimentation basin, causes particulate matter suspended in the stormwater to settle out of the water column. Water-quality data for the ponds compared to data for stormwater inflows supports this conclusion by clearly indicating a significant improvement in quality after the stormwater passes through the ponds (see POP, Appendix D).

6.1.2 Association of Radionuclides with Suspended Solids

Data from stormwater collected at RFETS from 1991 through 1995 indicate that radionuclides are associated with solids suspended in the stormwater (measured as total suspended solids; TSS). Extensive discussion of studies with respect to association of radionuclides with particulate material is included in the POP, Appendix C. Based on these studies and for the purposes of this document, the following characteristics regarding Pu in soils are postulated or assumed:

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1. Pu forms a strong association within soils.

2. Pu transport is generally slow and aided by the presence of pedogenic factors which increase perviousness of the soil.

3. Environmental deposits of Pu at the Site occur and decrease quickly within a foot of the soil surface.

4. Pu occurs disproportionately attached to smaller particles, perhaps dependent, in part, on the greater availability of adsorption sites per unit weight for smaller versus larger particles.

5. Surficially localized Pu is potentially available for transport by wind and water erosional forces.

6.1.3 Relationship Between Stormwater Flows and Radionuclide Activities

Increasing intensity of precipitation events generate higher stormwater flows; resulting in increased TSS transport because of ditch and wetland scouring, sheet flow on bare soils, and raindrop impact. Consequently, since radionuclides are documented to associate with suspended solids, relationships between stormwater Pu activity and flow rates should exist. These relationships can be used to estimate the Pu loading into the ponds for any given inflow rate.

The addition of any future stormwater monitoring data that may be collected could facilitate the development of better water quality correlations for the detention pond stormwater inflows. It is expected that as data become available, the following relationships and the resulting previously agreed upon operations may be modified after consultation with all concerned parties.

A- Series

Gaging stations SW092, SW093, and GS13 monitor inflows to the A-Series ponds. SW092 and GS13 are co-located just above the A-1 Bypass on North Walnut Creek (Figure 2-3). SW093 is located approximately 1000 feet upstream from GS13, but there are no significant tributary inflows between SW093 and GS13. Correlation between both Pu and Am and flow could not be determined based on the analysis of empirical data collected at these locations. This may be a result of several factors:

1. The area draining to these sites may be large enough, and contain a wide variety of source areas, such that variability of areal precipitation distribution influences water quality at the gages. For example, precipitation for one storm may fall heavily on a contaminated source area, resulting in contaminated runoff. Likewise, a similar size precipitation event may fall

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heavily on relatively clean areas, resulting in cleaner runoff. Consequently, for the same flow, the water quality can be very different.

2. Runoff hydrographs at gaging stations GS13 and SW093 often show two peaks. This phenomena may indicate that runoff is originating from two or more distinct drainages that come together near the gages. These drainages are:

   - The area inside the Protected Area that drains to these gaging stations is characterized by potential contaminant source areas, large impervious areas, and flow paths in ditches and stormwater conveyance structures. Similarly, the Protected Area (PA) contains many smaller drainages that all have different times of concentration of stormwater runoff.

   - The area north of the PA (original N. Walnut Creek channel) is characterized by presumably uncontaminated source areas, vegetated pervious slopes, and a more indirect flow path.

These drainage characteristics, coupled with the fact that it is difficult to automatically sample multiple peak flows for every storm event (the magnitude and duration of runoff events is impossible to predict), may result in variable water qualities for the same runoff magnitudes in North Walnut Creek.

The highest activity of Pu measured for all the A-Series stormwater inflow samples was 5.3 pCi/L measured at a flow of 1.08 cfs. In order to establish a relationship between flow and radionuclide activity for the A-Series inflows (a required input for modeling), a 'worst case' relationship was established using this data point (Figure 6-1). This 'cutoff line' represents the maximum expected Pu loading for inflows to the A-Series ponds based on available data.

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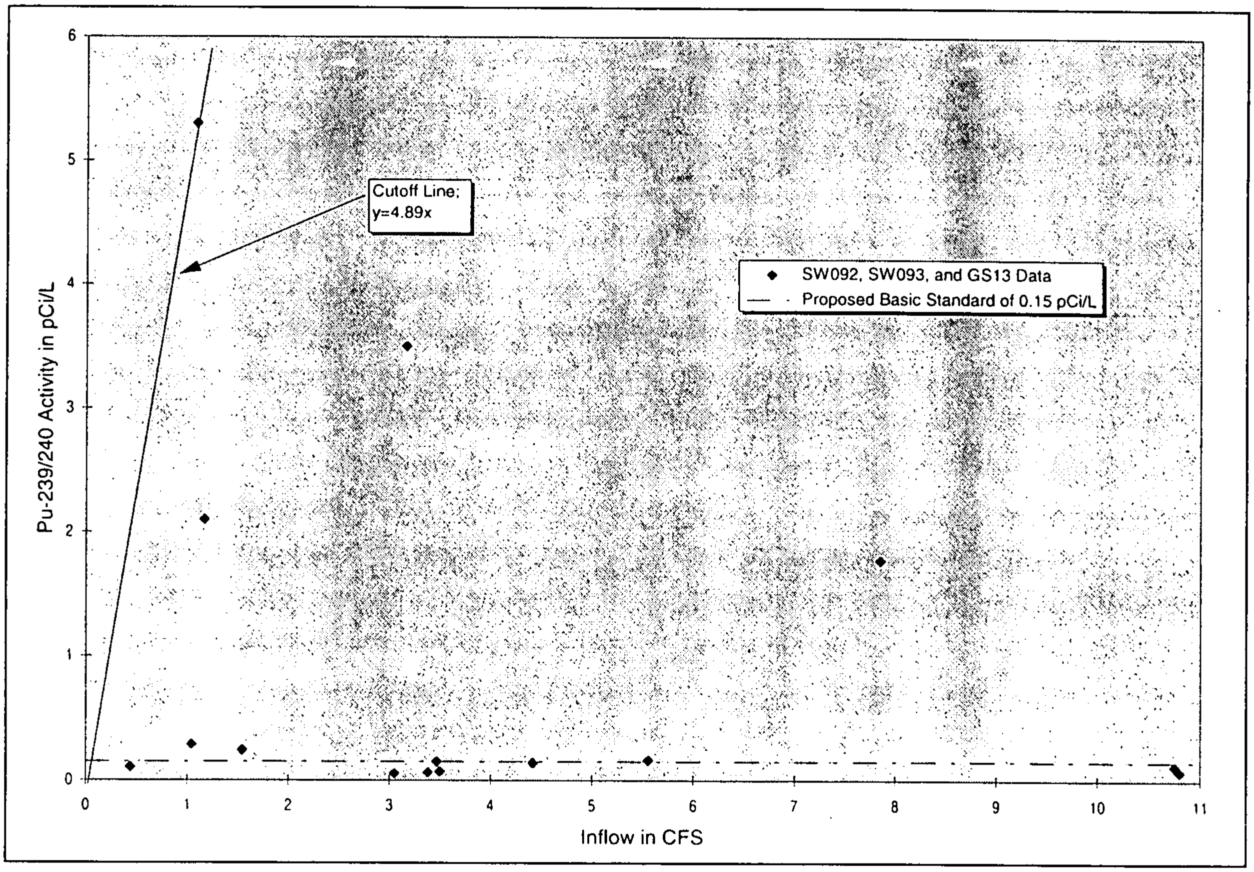

Figure 6-1. Variation of Plutonium Activity with Inflow for North Walnut Creek

B- Series

Stormwater quality data for the B-Series inflow come from gaging stations SW023 and GS10. Both stations are co-located just upstream of the B1 Bypass on South Walnut Creek. When examining the relationship between flow and Pu activity using all the data points from 1991 to 1995, no good statistical correlations could be determined. However, by separating and excluding certain data points that appear to be from different populations, the fit in Figure 6-2 was generated. Table 6-1 lists the excluded data along with the reasons for their exclusion and Figure 6-3 shows all data with the excluded data points labeled.

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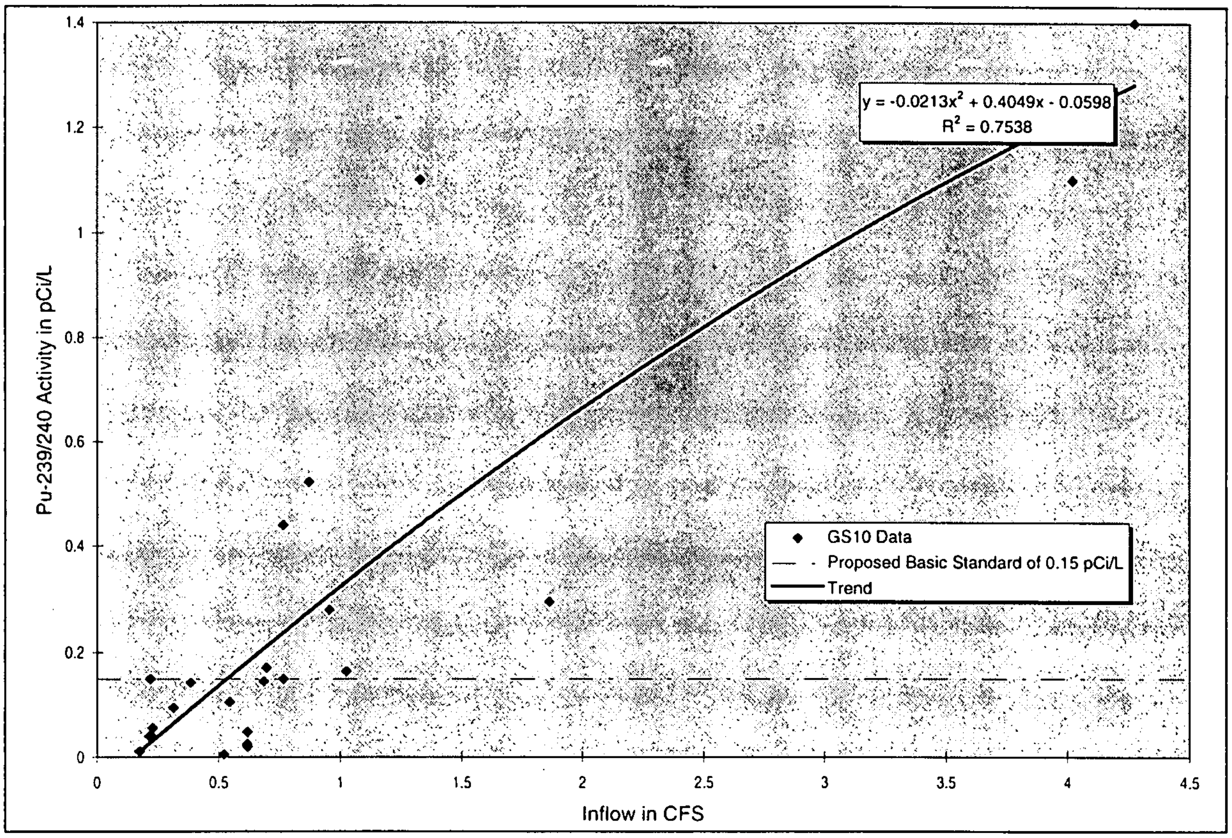

Figure 6-2. Variation of Plutonium Activity with Inflow for S. Walnut Creek

Table 6-1. Stormwater Quality Data Excluded from B-Series Inflow Analysis

Dates	Reason / Effect
prior to 4/1/93	Prior to 4/1/93, flow was being measured at a 90° V-notch weir device that was considered unreliable for accurate flow measurement. The weir was often overtopped for storm events, and flow values had to be estimated. In April 1993, a reliable Parshall flume was installed.
5/17/93	This sample was a grab sample for the OU6 Synoptic Sampling Event. Since the other samples at this location are composites that are paced to sample the rising limb and peak of a runoff hydrograph, this sample was considered incongruous. This action is conservative since the Pu activity was relatively low (0.19 pCi/L) for a flow of 2.48 cfs.
4/26/95	This sample was for a hydrograph generated from a snowmelt event. Since snowmelt is generally of low intensity and contains less TSS (no raindrop impact scouring), it was determined to be incongruous with rainfall event samples. This action is conservative since the Pu activity was relatively low (0.27 pCi/L) for a flow of 5.45 cfs.
5/17 to 6/28/95	These 4 samples were dropped because they all were sampled during high flow rates, and relatively low Pu activities; a conservative action. This phenomena is thought to be caused by the extremely large event on 5/16/95 to 5/17/95. It is postulated that this large event flushed substantial quantities of transportable and potentially contaminated sediments from ditches and culverts. Therefore, during subsequent runoff events there was less contaminated sediment available for transport. The modified geometry of the ditches and culverts might also have acted as sediment traps for the relatively lower intensity events that followed.

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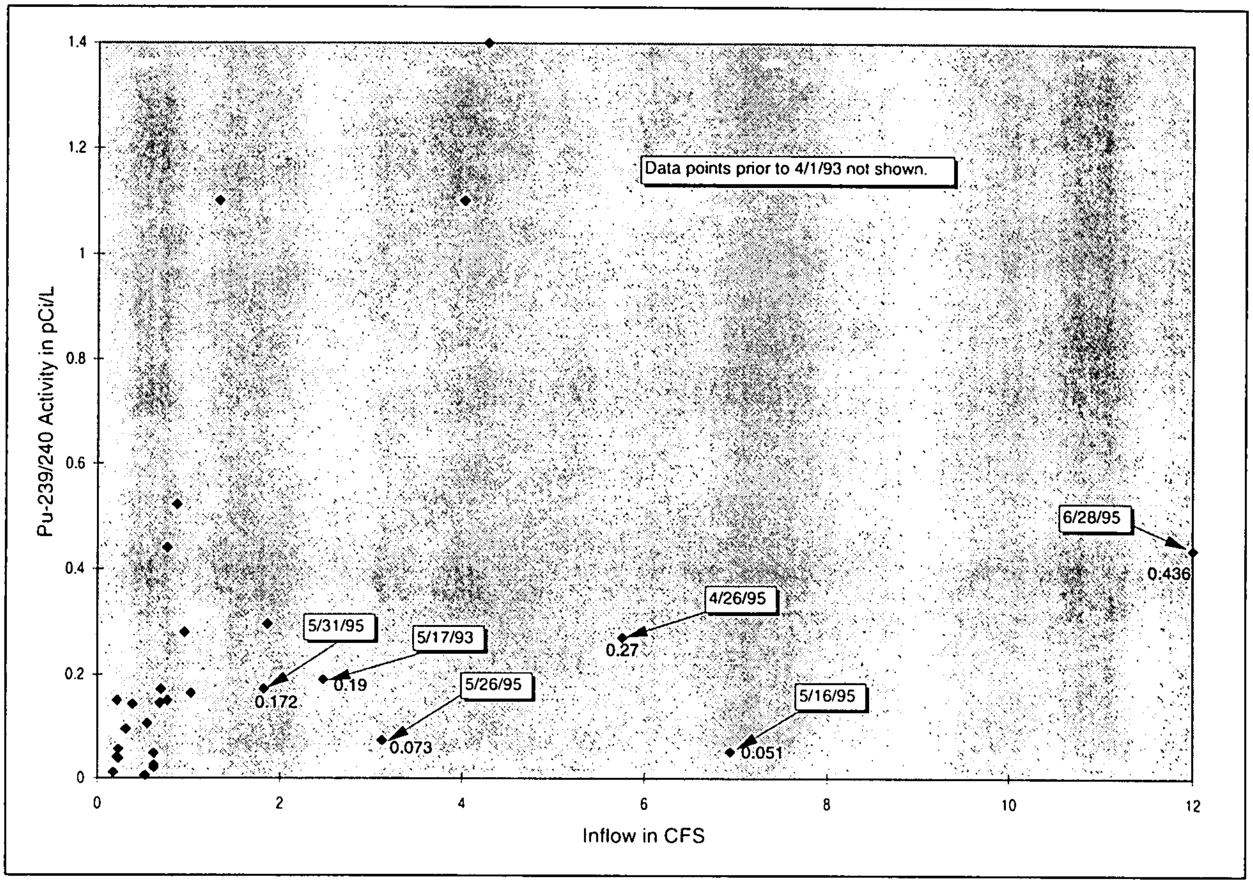

Figure 6-3. Variation of Plutonium Activity with Inflow for South Walnut Creek Showing Excluded Data Points

SID / C-2 System

Stormwater quality data for the Pond C-2 inflow are collected at gaging station SW027. This station is located on the SID where dual 60" cmps on the SID discharge to Pond C-2. Prior to April 1995, reliable flow data were not collected at this location. In April 1995, SSW installed dual 120° V-notch weirs to facilitate accurate flow measurement in support of the IA IM/IRA. Since that time, SSW has collected 11 stormwater samples at SW027, and received analytical results for six samples. Consequently, correlations between radionuclide activities and stormwater flows using only 6 data points can not be determined at this time.

6.1.4 Particle Settling and Associated Actinide Removal

It was established in Section 6.1.2 that radionuclides form associations with suspended solids in stormwater. It is also accepted that, in a detention pond setting, suspended particles of larger size

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generally settle more rapidly than do smaller size particles. Therefore, in order to model the capacity of the detention ponds to remove radionuclides by settling, the different sizes of suspended particles, and their respective settling velocities, must be known for a given volume of stormwater. This information, in conjunction with a relationship between the quantity of radionuclides associated with varying particle sizes, can be used to determine the amount of radionuclides removed by settling of suspended particles. This section describes how the various components of suspended particle size, settling velocity, and association with radionuclides were determined and how they fit into the overall radionuclide removal model.

Size Distribution of Suspended Particle Sizes

The distribution of suspended sediment particle sizes in stormwater in the A- and B-Series drainages was the subject of a study conducted in 1992 (AMAX, 1992). Suspended sediments were sieved and filtered to determine the distribution of particle sizes ranging in diameter from 1 micron (1x 10-9 m) to more than 19,000 microns (19 cm). Data were reported in terms of the sample's cumulative percent mass larger than a particular particle size. In other words, for the sample collected at site SW093 (influent flow to Pond A-3) 100% of the total mass of the sample was for particles larger than 1 micron, approximately 97% of the mass was for particles larger than 75 microns, and so on up to 0% of the samples' mass contained in particles larger than 19,050 microns. Table 6-2 shows the distribution of particle sizes for samples collected at sites SW093 and SW023. For each drainage, these data were plotted and equations were developed for unique particle size distribution curves (See Figure 6-4 and Figure 6-5).

Table 6-2. Particle Size Distribution in Stormwater Samples

		A-Series Ponds SW093		B-Series Ponds SW023	
Mesh Size	**Opening (μm)**	**Cum. %**	**% less than**	**Cum. %**	**% less than**
.75 in	19050	0.00	100.00	0.00	100.00
.375 in.	9525	4.90	95.10	1.50	98.50
#4	4750	12.40	87.60	6.10	93.90
#10	2000	35.10	64.90	28.60	71.40
#40	425	77.90	22.10	86.60	13.40
#200	75	97.30	2.70	97.60	2.40
-200	1	100	0.00	100	0.00

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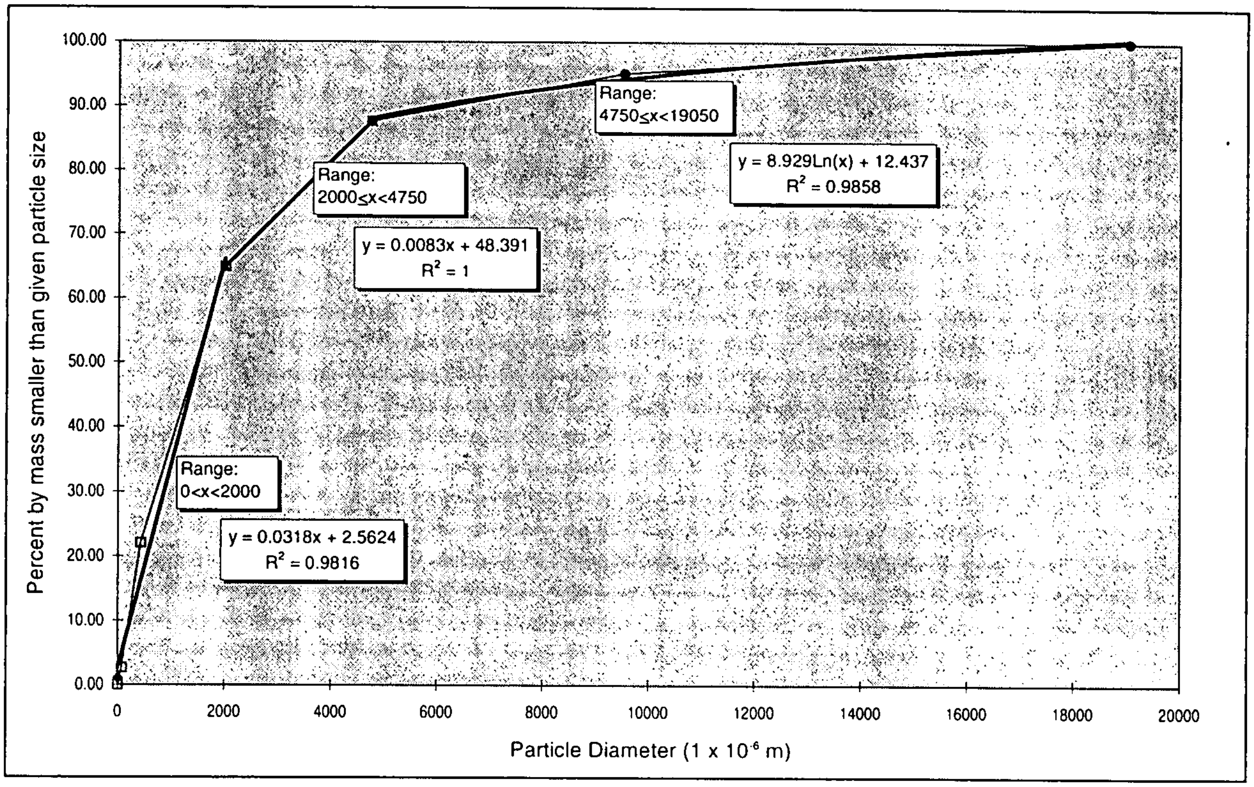

Figure 6-4. North Walnut Creek TSS Particle Size Distribution: Gaging Station SW093

Adsorption of Plutonium to Particle Surfaces

Although the distribution of particle sizes was determined for the suspended sediments of each drainage, no data exists for the distribution of radionuclides, particularly Pu, amongst the different particle sizes in suspended sediments. Because modeling the partitioning of Pu to various particles based on particle surface chemistry is complex and uncertain, the assumption was made that all surface areas of suspended particles are equally attractive to the actinides, regardless of the particle diameter. Therefore, the premise was made that Pu adsorbed to suspended particulate matter is evenly distributed over the surface area of all suspended particles in a given volume of stormwater.

- **Assumption:** Adsorbed Pu is distributed among stormwater TSS particles based on available surface area for given particle sizes.

Distribution of Surface Area Amongst Particles

In order to estimate the total surface area of all suspended particles in a given volume of stormwater, it was assumed that all such particles are spherical. This allowed for calculation of a particle's surface area based on the diameter of that unique particle.

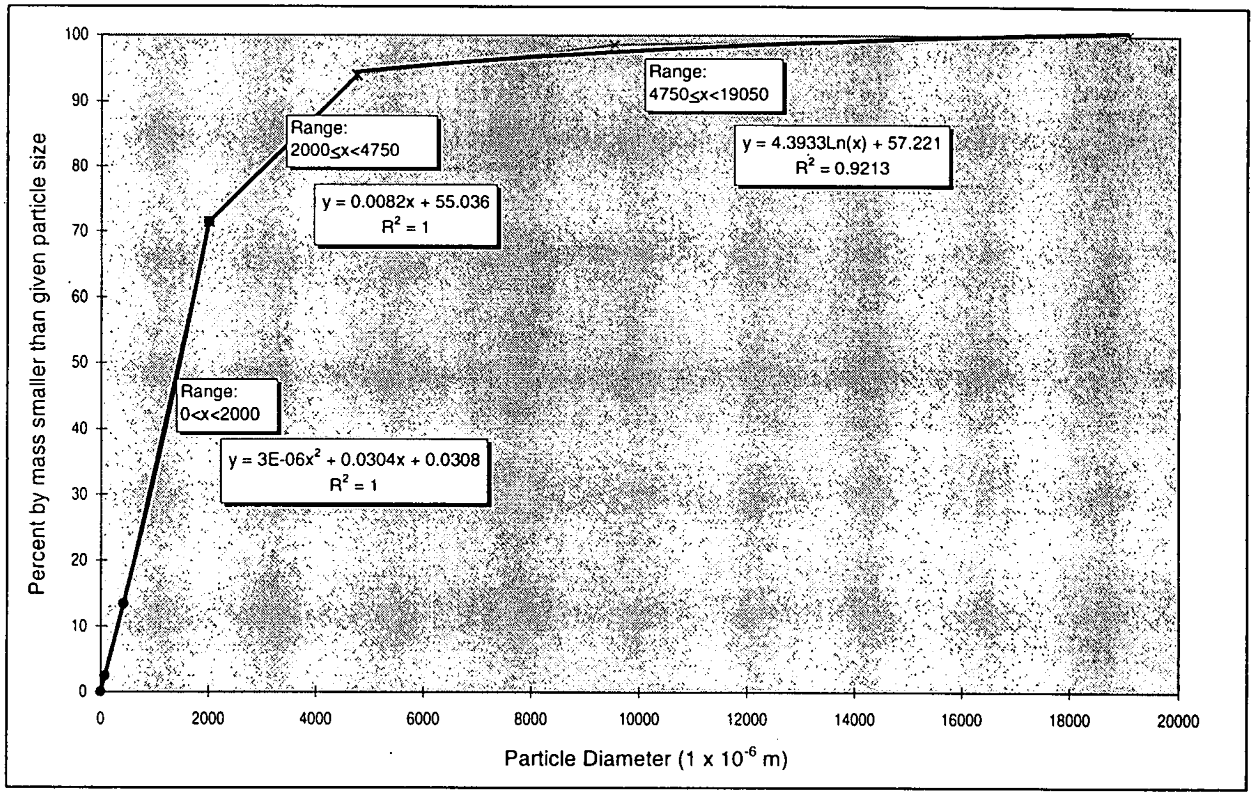

Figure 6-5 South Walnut Creek TSS Particle Size Distribution: Gaging Station SW023

- **Assumption:** Total suspended sediment particles are spherical.

Building on this assumption, the surface area to volume ratio can be calculated for all particle sizes. Assuming that the density of the various size particles is equal, the surface area to volume ratio represents a normalized surface area to mass ratio. The particle size distribution, based on mass, can then be converted to a distribution of total surface area of all particles. Because the smaller diameter particles have a larger surface area to mass ratio than do the larger particles (based on the assumption of spherical particle geometry) the majority of the total surface area is located on the smaller diameter particles. The surface area distribution for particles in each drainage is shown in Figure 6-6.

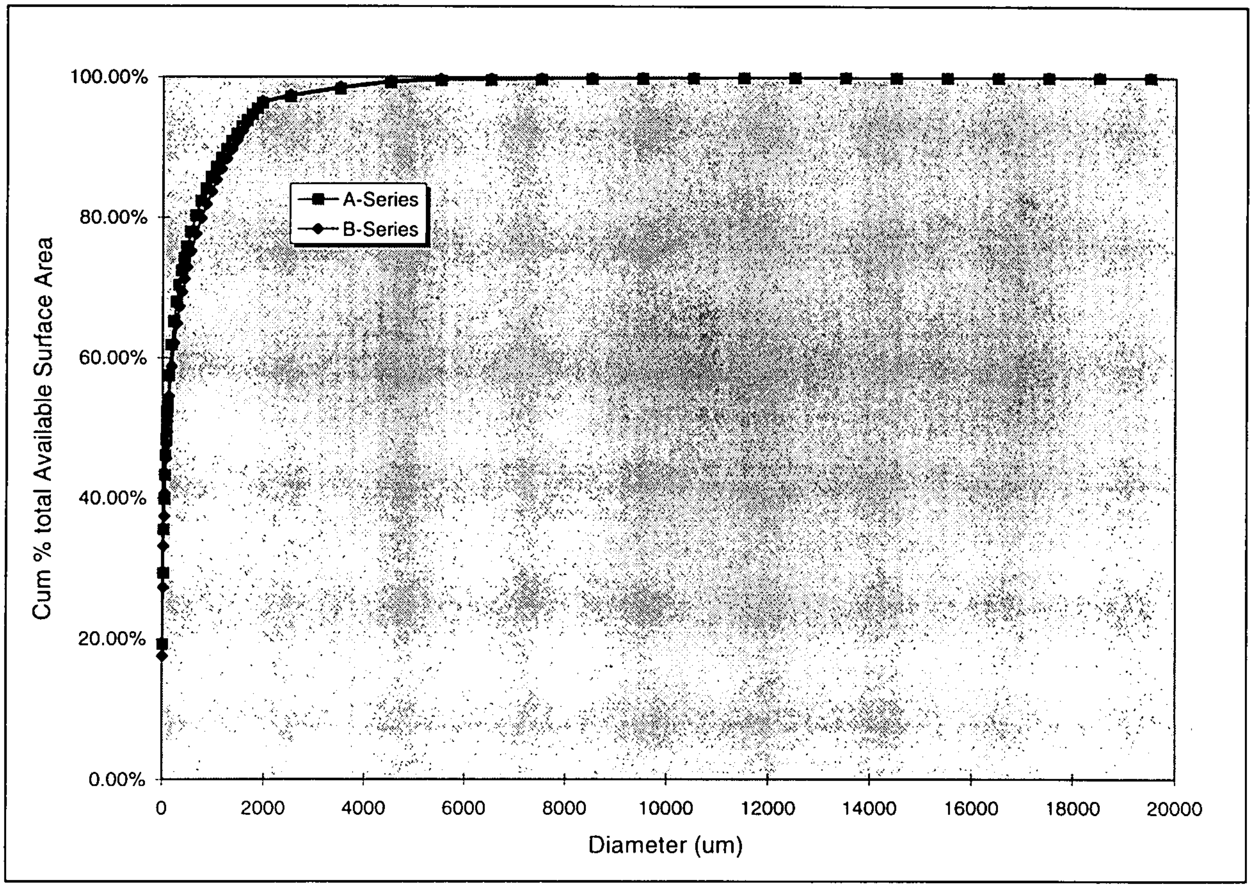

Figure 6-6. Relationship Between Cumulative Particle Surface Area and Particle Size for North and South Walnut Creek: Gaging Stations SW023 and SW093

Particle Settling Velocity

The settling velocity of a particle in water is commonly calculated using Stokes' Law, which relates the settling velocity as proportional to the particle's density and the square of the particle's cross-sectional diameter (Thomann, 1987). Other research has found particle settling velocities to be an order of magnitude higher, or more rapid, than Stokes' Law (Thomann, 1987). Yet another study developed a rating curve where settling velocities were nearly one order of magnitude lower, or slower, than the Stokes' Law rate (Reynolds, 1982). In order to use the most conservative approach, the latter of these studies was used to determine settling velocities for different sizes of particles. By choosing the most conservative settling velocity relationship, the settling efficiency of the ponds is more likely to be underestimated versus overestimated.

In addition to choosing a conservative relationship for particle size versus settling velocity, the density of the suspended particles was assumed to be 2.2 gm/cm^3, representing the lower range of density associated

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with sediments composed of SiO_2[f]. The lower density also translates to a more conservative, less rapid settling velocity. A plot of settling velocity versus particle diameter, based on the conservative assumption for particle density and the conservative rating curve for particle size versus settling velocity, is shown in Figure 6-7.

- **Assumption:** The density of the suspended sediment particles is 2.2 g/cm^3. This assumption results in a more conservative, less rapid settling rate as it represents the lower density range for sediments composed of SiO_2.

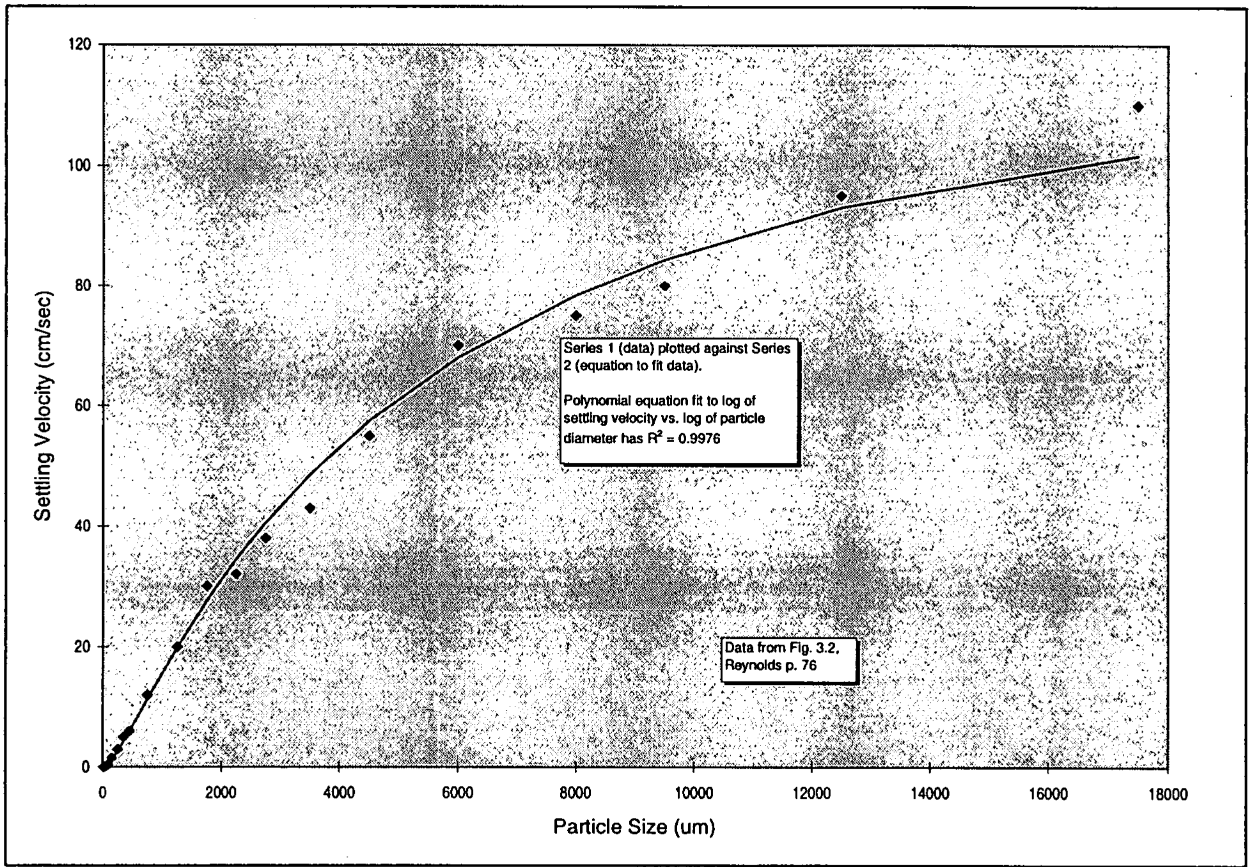

Figure 6-7. Theoretical Relationship Between Settling Velocity and Particle Size

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[f] SiO_2 compounds, as listed in the CRC Handbook of Chemistry and Physics, range in density from 2.2 g/cm^3 to 2.6 g/ cm^3. The lower value in this range was used for this model.

Particle Surface Area Distribution Versus Settling Velocity

The distribution of the particles' sum surface area, based on particle size, can be combined with the settling velocity unique to each particle size to produce a correlation of particle surface area to settling velocity as shown in Figure 6-8. This curve is a settling velocity rating that can be used to estimate the fraction of actinide that settles to the bottom of a detention pond (since Pu and Am are assumed to be evenly distributed on all surface areas; see sec. 6.1.4) given the physical parameters of a detention pond.

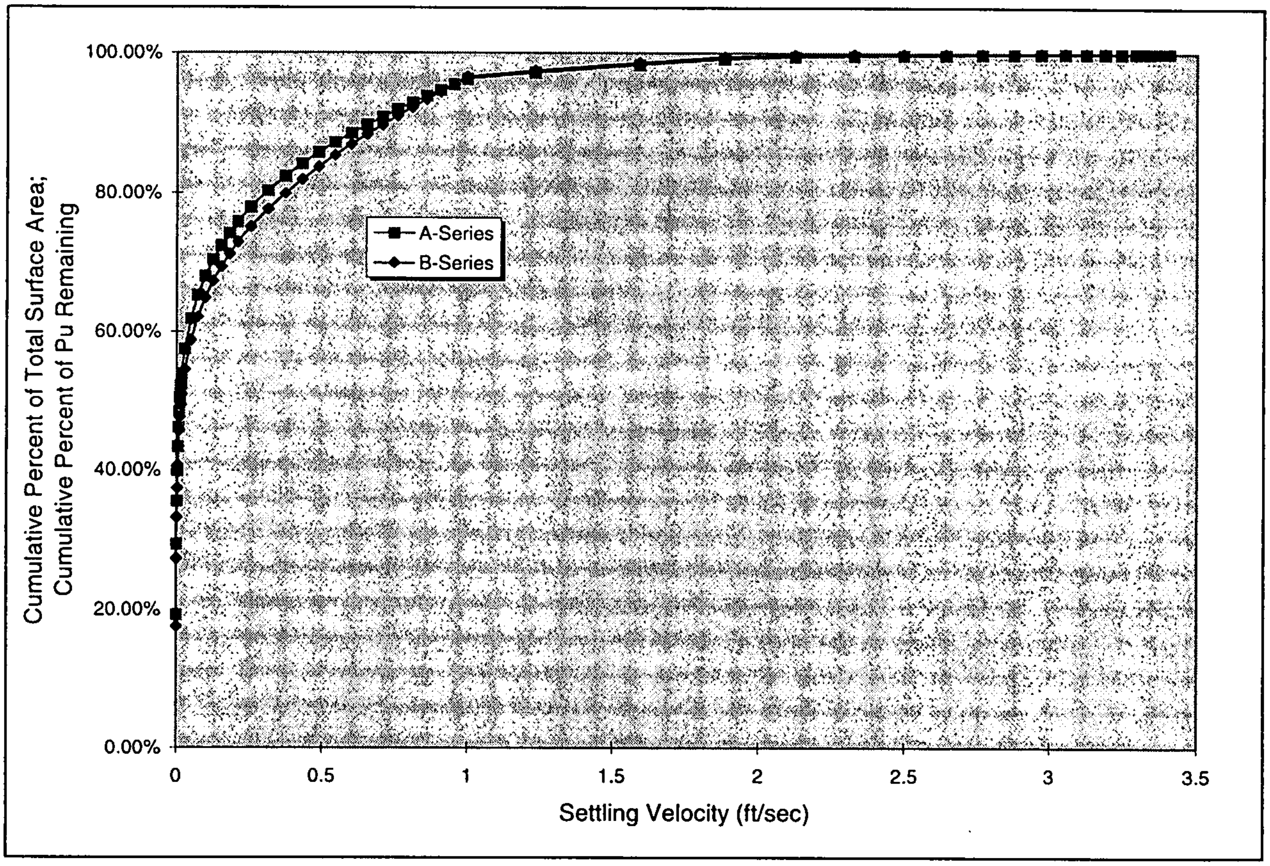

Figure 6-8. Modeled Relationship Between Cumulative Surface Area / Percent Remaining Plutonium and Settling Velocity for North and South Walnut Creek Suspended Solids.

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6.2 CONTROLLED DETENTION ATTENUATION MODELING

6.2.1 Conceptual Models

A- Series

Stormwater from the IA that flows into the A-Series drainage goes directly to Pond A-3, via the A1 Bypass, bypassing Ponds A-1 and A-2 which are not hydraulically linked to the rest of the series (Figure 2-3). Water flows from Pond A-3 into Pond A-4 before being released offsite via Walnut Creek. The controlled detention attenuation model for the A-Series drainage takes into consideration the settling characteristics of Ponds A-3 and A-4 (Figure 6-9).

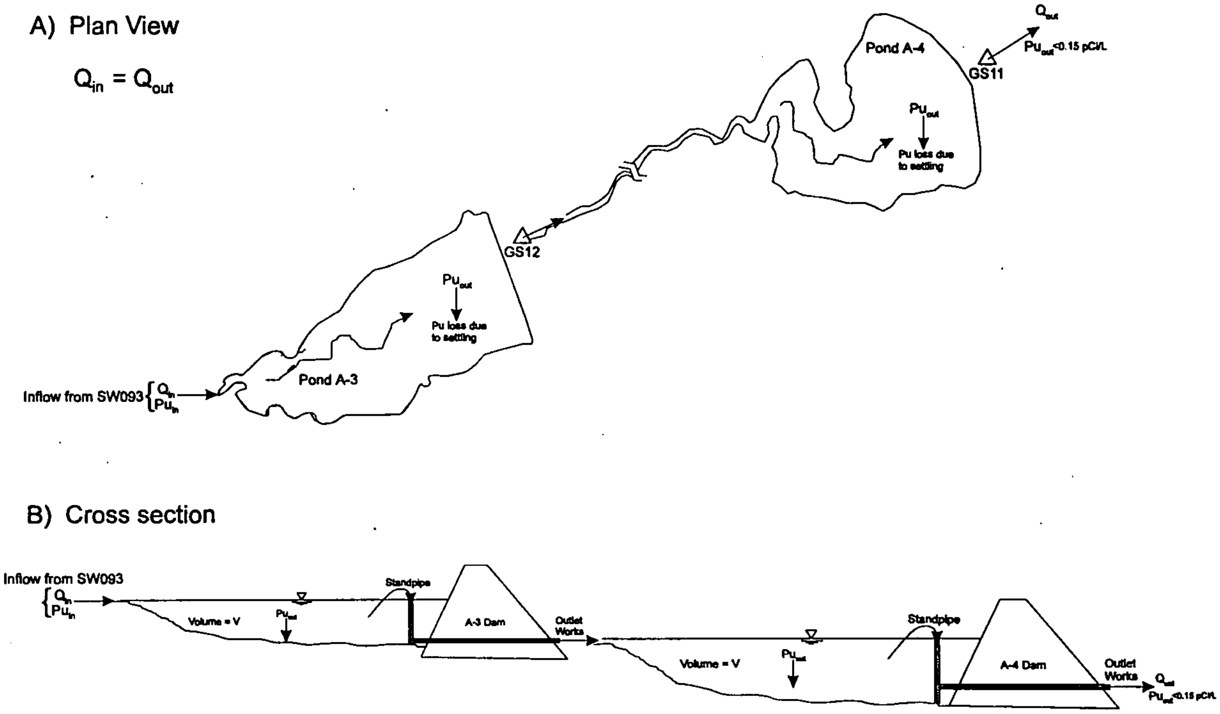

Figure 6-9. Conceptual Controlled Detention Model for North Walnut Creek.

B-Series

Stormwater from the IA that flows into the B-Series drainage goes directly to Pond B-4, via the B1 Bypass, bypassing Ponds B-1, B-2, and B-3 (Figure 2-3). Ponds B-1 and B-2 are isolated ponds; not linked to the rest of the series. Pond B-3 currently receives treated water from the WWTP. Outflow from Pond B-3 flows to Pond B-4 , where it mixes with stormwater flowing in from the IA. Water flows from Pond B-4 into Pond B-5 before being released offsite via Walnut Creek.

Stormwater quality data indicate no consistent improvement in water quality, in terms of TSS or Pu activity, in samples collected upstream and downstream of Pond B-4. This is likely a result of the small surface area and shallow depth of Pond B-4, which limit its solids removal effectiveness. Therefore, the controlled detention attenuation model for the B-Series drainage is based on the settling characteristics of Pond B-5 only (Figure 7-9).

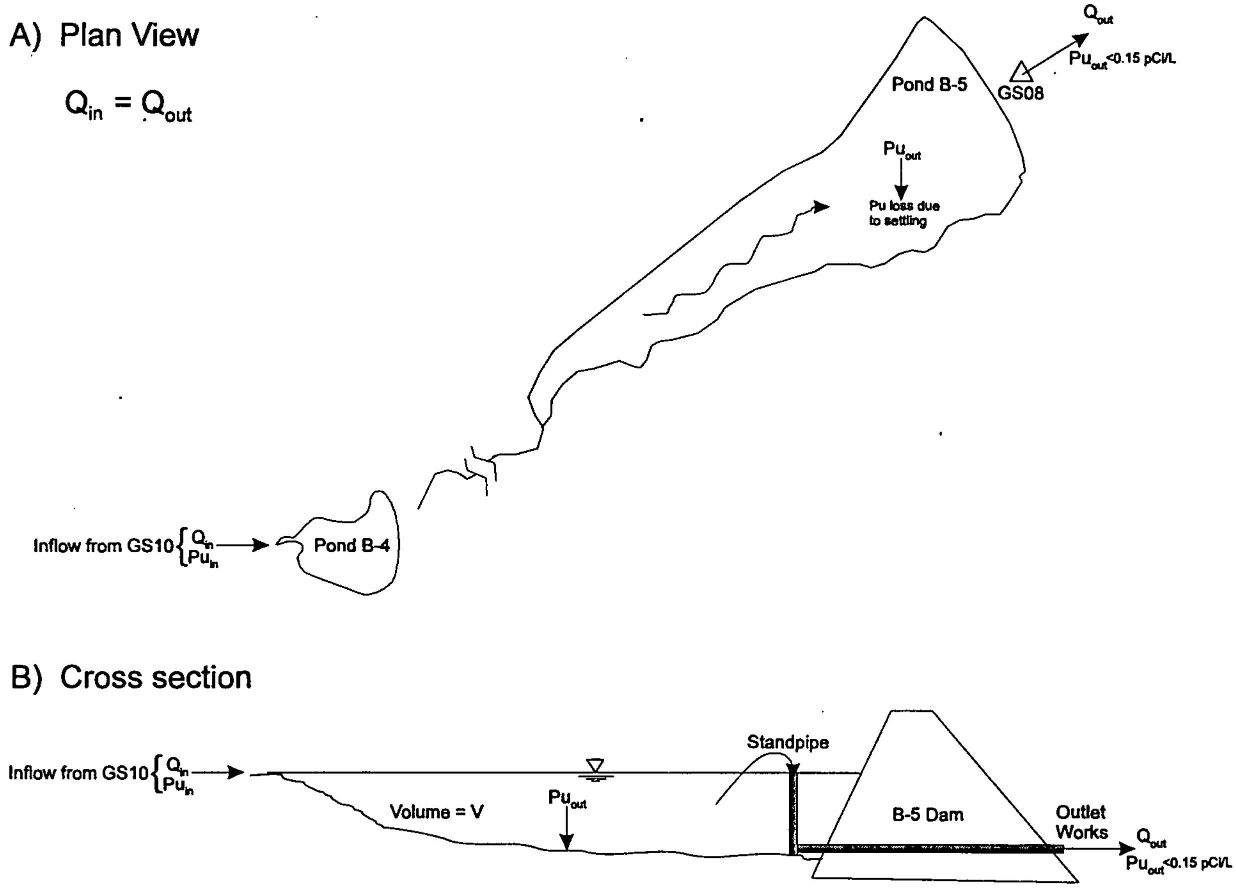

Figure 6-10. Conceptual Controlled Detention Model for South Walnut Creek

SID / C-2 System

Stormwater from the IA that flows into the SID / C-2 system originates primarily in the 400 and 800 Areas (Figure 2-3). Historically, the stormwater inflow volumes to Pond C-2 require only a single batch discharge operation per year. Due to these relatively small volumes, coupled with the inability to establish a relationship between radionuclide activity and flow rates at SW027, a controlled detention mode of operation is not planned for Pond C-2. Therefore, Pond C-2 will continue to be operated in batch mode; using the Pond C-2outlet works once upstream and downstream engineering improvements are in place to the satisfaction of concerned parties. This batch mode of operation is expected to be the simplest and least expensive option given current management tools. The proposed conceptual model

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and criteria for discharge is described in Section 6.4, and the operational protocol is outlined in Section 7.1.3.

6.2.2 Theoretical Controlled-Detention Model

Continuous Flow Sedimentation Basin Modeling

- **Assumption:** Site detention ponds (the Ponds) can be modeled as ideal settling basins.

To model the removal of TSS from stormwater as it flows through the Site detention ponds, the Ponds were assumed to act as ideal settling basins (Figure 6-11). The ideal settling basin theory was utilized because of its ease of application. Ideal settling basin theory assumes the following conditions:

1. The settling is Type I settling - in other words, settling of discrete particles without coagulation is assumed as discussed in the previous section.

2. There is a uniform distribution of flow entering the basin.

3. There is a uniform distribution of flow leaving the basin.

4. There are three zones in the basin: (1) the inlet zone, (2) the outlet zone, and (3) the sediment zone.

5. There is a uniform distribution of particles throughout the depth of the inlet zone.

6. Particles that enter the sediment zone remain there and particles that enter the outlet zone leave the basin.

Obviously, the Site ponds are not ideal settling basins. Therefore, application of this theory provides an estimate of actual settling. Conservative assumptions are made to account for the effective particle settling efficiency of the Ponds and increase the applicability of the model. These assumptions will be detailed in the following discussion. Analysis of any water quality data that may be collected in the future could be used for model verification and may indicate that the models could be made less conservative. Any subsequent changes in the previously agreed upon pond operations would be made pending consultation with all concerned parties.

Figure 6-11 shows an ideal rectangular settling basin of length, L, a width, W, and a depth, H. V_o (the critical settling velocity) is the settling velocity of the smallest (slowest settling) particle size that is 100% removed. When a particle of this size enters the basin at the water surface (point 1), it has a trajectory (as shown) that intercepts the sediment zone at point 2, which is at the downstream end of the basin.

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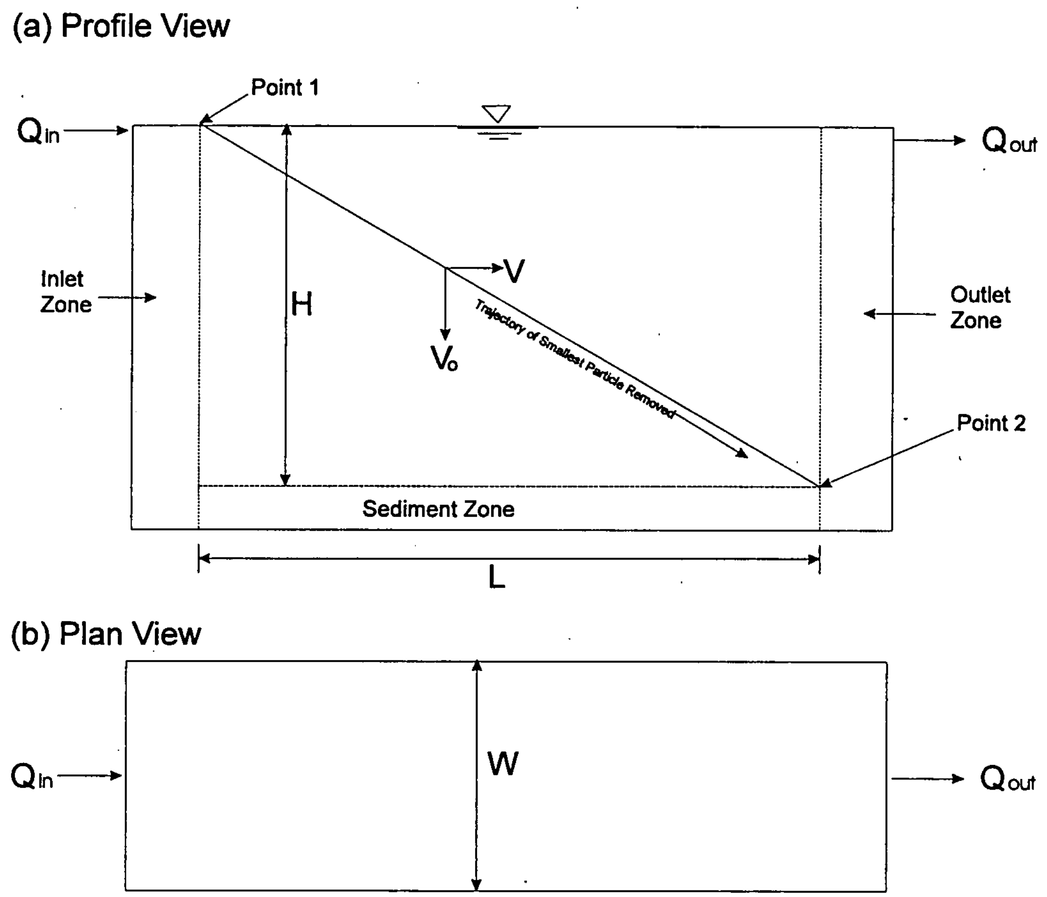

Figure 6-11. Ideal Rectangular Settling Basin as Modified for Site Detention Ponds[g]

- **Assumption:** All TSS particles enter at the top (water surface) of the Ponds.

In actuality, some particles may enter at some depth below the water surface, which would result in a more preferential removal due to the shorter distance to reach the sediment zone. Consequently, by assuming that all TSS enters at the water surface, all particles must travel the longest possible distance to the sediment zone, the depth H; a conservative assumption.

- **Assumption:** All TSS particles must reach the sediment zone to be removed.

[g] Adapted from Reynolds, T.D. *Unit Operations and Processes in Environmental Engineering*. PWS-KENT Publishing Company, Boston. 1982.

In actuality, some particles that enter the outlet zone near point 2 may also be removed. The outlets works for the Ponds are designed to be standpipes that will maintain some minimum depth (determined by modeling results and based on dam safety and settling efficiency effects discussed below). Therefore, some particles that do not settle before reaching point 2 may be removed since they may still not reach the standpipe opening. This is yet another conservative assumption.

- **Assumption:** Detention ponds remove stormwater TSS based on Hazen's surface load theory.

Derivation of overflow rate:

The detention time for any given particle that enters the basin, t, is equal to the depth, H, divided by the critical settling velocity, V_o, or

$$t = \frac{H}{V_o} \qquad \text{Eqn. 6-1}$$

The detention time, t, is also equal to the length, L, divided by the horizontal velocity, V, or

$$t = \frac{L}{V} \qquad \text{Eqn. 6-2}$$

The horizontal velocity, V, is equal to the flow rate, Q, divided by the cross-sectional area of the basin, HW, or

$$V = \frac{Q}{HW} \qquad \text{Eqn. 6-3}$$

Combining Eqns. 6-2 and 6-3 to eliminate V gives

$$t = \frac{LWH}{Q} = \frac{\forall}{Q} \quad \text{where } \forall \text{ is the basin volume} \qquad \text{Eqn. 6-4}$$

Equating Eqns. 6-1 and 6-4 gives

$$V_o = \frac{Q}{LW} = \frac{Q}{A_p} \equiv \text{overflow rate} \left[\frac{\text{length}}{\text{time}}\right] \qquad \text{Eqn. 6-5}$$

where A_p is the plan area of the basin

3P

Equation 6-5 shows that the overflow rate (which is unique to any given set of basin conditions) is equivalent to the settling velocity of the smallest particle that is 100% removed. Therefore, in a controlled detention situation, the TSS settling efficiency (a % mass removed) of a settling basin depends on three criteria:

1. The flow rate through the basin;

2. the plan area of the basin available for particle deposition (determined from Pond capacity/surface area data); and

3. the distribution of TSS particle sizes and their corresponding settling velocities for the given stormwater inflow.

- **Assumption:** Detention pond volumes remain constant for all modeled influent stormwater flows according to outlet elevations.

During stormwater loading to the Ponds, the levels are expected to fluctuate depending on the transient nature of the inflows and outflows. However, these changes are expected to be small since the outlet works on the Ponds can handle flows up to 30 cubic feet per second, and stormwater inflows are **rarely** seen at this magnitude. By holding the pond elevations in the model at the lowest expected volumes, the corresponding plan area for TSS deposition is minimized, consequently minimizing the critical settling velocity; a conservative assumption.

- **Assumption:** There exists some minimum settling basin depth below which turbulence, diffusion, and local velocities may result in sediment resuspension.

Urbonas and Stahre (1993) recommend that the average settling basin depth be no less than 3.5 feet. Therefore, as a conservative estimate, it was assumed that there is no settling in any portions of the Ponds where the water depth is less than 3.5 feet. Under this assumption, the pond area available for sediment deposition is reduced, consequently increasing the critical settling velocity, and reducing the overall TSS removal estimate. This is also a conservative assumption.

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Assumption: There exists some rate of stormwater inflow (and corresponding constituent load), for any given detention pond, such that the critical settling velocity is slow enough for TSS and associated actinide removal, that the Proposed Basic Standard will be achieved.

For both the A-Series and the B-Series ponds, the radionuclide activities in stormwater can be expressed as a function of flow as in section 6.1.3.

$$[\text{Pu}] = f(Q)\,; \quad \text{where } Q \equiv \text{ flow in cfs} \qquad \text{Eqn. 6-6}$$

The functions are as follows:

$$\begin{aligned} &\text{A-Series: } [\text{Pu}][\text{pCi / L}] = 4.89(Q) \\ &\text{B-Series: } [\text{Pu}]\,[\text{pCi / L}] = -0.0213(Q)^2 + 0.4049(Q) - .0598 \end{aligned} \qquad \text{Eqn. 6-7}$$

Not all of the influent actinide is available for settling (see 6.1.2); a portion is associated with unsettleable particles. Consequently, some minimum activity remains after settling, and this amount must be subtracted from the calculated influent activity, to give an amount available for settling. The minimum attainable activity was determined by examining the analytical data for the terminal ponds, and finding the minimum measured value plus its analytical error. For Pond A-4 this value was zero pCi/L Pu, and for B-5 it was 0.004 pCi/L Pu.

For any given flow and pond level, the overflow rate (critical settling velocity) can then be calculated as

$$V_o = \frac{Q}{A_p} = \frac{Q}{f(\text{ pond level})} \qquad \text{Eqn. 6-8}$$

This calculated critical settling velocity can then be compared with the settling velocities for given particle sizes from Section 6.1.4 to yield a value for the percent Pu removal, and consequently an effluent Pu activity.

$$\%\text{ Pu removal } = f(V_o) \qquad \text{Eqn. 6-9}$$

$$\text{Effluent Pu [pCi / L]} = (100\% - \%\text{Pu removal})(\text{available influent Pu}) + \text{ min. attainable Pu}$$

Equations 6-6 through 6-9 can then be solved iteratively using a computer spreadsheet to determine the maximum acceptable stormwater inflow while maintaining the effluent Pu activity below the Proposed Basic Standard of 0.15 pCi/L. Table 6-3 provides information on the model inputs and outputs.

Table 6-3. Controlled Detention Model Inputs and Outputs

INPUTS

Item	Description
Percent Pond Level [%]	Determined by the level of the proposed standpipes; this value is also used to determine the pond plan area for sediment deposition

OUTPUTS

Item	Description
Acceptable Stormwater Inflow [cfs]	Iteratively calculated for achievement of the Proposed Basic Standard
Influent Pu Activity [pCi/L]	Iteratively calculated based on the empirical correlation between stormwater inflow [cfs] and Pu activity
Pond Overflow Rate V_0 [ft/sec]	Iteratively calculated based on inflow and pond plan area
% Pu Removal [%]	Iteratively calculated based on the theoretical relationship between particle settling velocity [ft/sec] and the % Pu removed

6.2.3 Model Results and Discussion

Flow Thresholds for Pu Removal During Controlled Detention

As discussed previously, the following values for recommended pond levels and stormwater inflow cutoff rates are subject to modification based on changes in the detention pond system parameters. Any changes to the previously agreed upon pond operations will only be made after consultation with all concerned parties.

A- Series Ponds—

Table 6-4 and Figure 6-12 show the controlled detention modeling results for North Walnut Creek. Since TSS settling efficiency is only as good as the efficiency associated with the minimum critical settling velocity for any given pond in a series (effluent particles from A-3 are reintroduced to the surface of A-4), the model was run for only A-4. In other words, since the plan area in A-4 is larger than for A-3, the resulting overflow rate is always smaller in A-4, then the maximum settling will be achieved in A-4. Any particles large enough to be settled in A-3, would also be settled in A-4. Therefore, A-3 can be used to control the inflow rate to A-4 to maximize actinide removal efficiency.

Pond A-3 will have a minimum elevation of 10% to maximize stormwater attenuation and detention capacity, but the level in A-3 will fluctuate with varying stormwater inflows. Outflow rates from A-3 will be managed to control the inflow rate to Pond A-4. Consequently, the elevation of Pond A-3 will vary in time as stormwater inflows pass through A-3. Pond A-4 will be held at 20% elevation (elevation

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of standpipe opening) to maximize the A-4 plan area while satisfying requirements for minimizing dam stresses and maximizing potential stormwater detainment capacity in the event that batch-mode operation is required. Operational protocol for maintaining these levels and detaining stormwater is detailed in Section 7.

Table 6-4. Controlled Detention Modeling Results for North Walnut Creek

Pond A-3 Level: 10%
Pond A-4 Level: 20%
Minimum Attainable Pu Activity [pCi/L]: 0.0 [see sec. 6.2.2]

Pond A-4

Q_{in} [cfs]	Expected Available A-3 Pu_{in} [pCi/L]	A_p : A-4 Plan Area [ft^2]	V_0 : Overflow Rate [ft/s]	%Pu Removal	Pu_{out} [pCi/L]
0.58	2.84	97545	5.95E-06	94.7%	0.15

Maximum Acceptable A-4 Inflow [cfs]: 0.58; controlled by A-3 outlet works

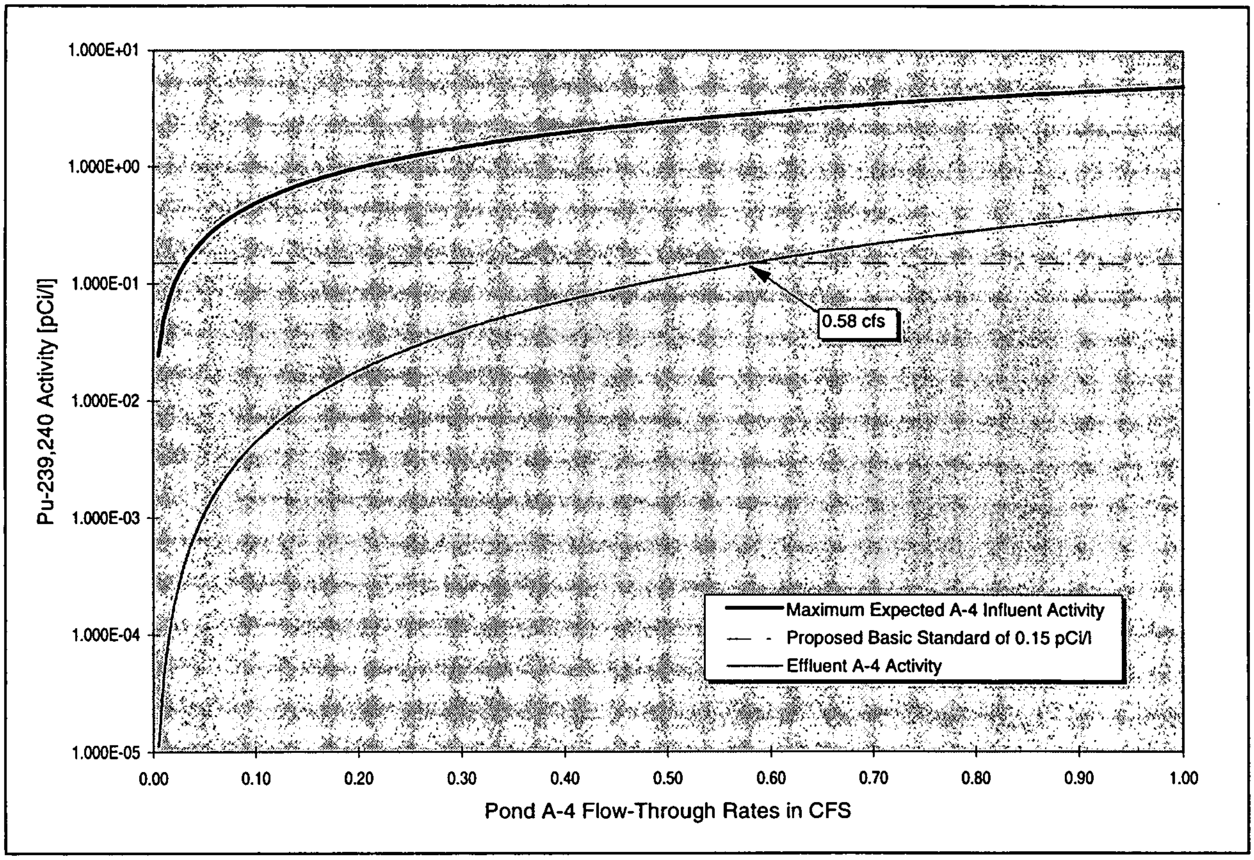

Figure 6-12. Water Quality Response for A-Series Ponds: Relationship Between Plutonium Activities and Flow Rates

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B- Series Ponds—

Table 6-5 and Figure 6-13 show the controlled detention modeling results for South Walnut Creek. Since Pond B-4 is not expected to reliably remove TSS, the model was run only for Pond B-5. Also, since the plan area in B-5 is larger than for B-4 (i.e. the resulting overflow rate is always smaller in B-5), maximum settling will be achieved in B-5. Any particles that are large enough to be settled in B-4, would also be settled in B-5.

WWTP effluent flows to the detention ponds are permitted only during daylight hours. Consequently, some storm event flows entering the detention ponds are mixed with WWTP effluent, while others are not. In the B-Series, WWTP effluent flows entering Pond B-4 have two effects on the TSS removal efficiency in Pond B-5: (1) the dilution of influent stormwater actinide activities, and (2) an increase in the critical settling velocity for Pond B-5. The dilution effects increase the acceptable controlled detention inflow rate, while the critical settling velocity increase will decrease the acceptable controlled detention inflow rate. An analysis of the effects of varying WWTP flows on the model results indicate that dilution effects are more influential than critical settling velocity effects. Therefore, by assuming that there is zero WWTP inflow during controlled detention operations, dilution effects are ignored, and a conservative flow threshold is obtained.

Pond B-5 will have a minimum elevation (elevation standpipe opening) of 10% to maximize stormwater detention capacity when inflows require batch-mode operation, while minimizing dam stresses. Operational protocol for maintaining these levels and detaining stormwater is detailed in Section 7.

Table 6-5. Controlled Detention Modeling Results for South Walnut Creek

Pond B-4 Level: controlled detention
Pond B-5 Level: 10%
Minimum Attainable Pu Activity [pCi/L]: 0.004 [see sec. 6.2.2]

Pond B-5

Q_{in} [cfs]	Expected Available B-5 Pu_{in} [pCi/L]	A_p : B-5 Plan Area [ft^2]	V_0 : Overflow Rate [ft/s]	%Pu Removal	Pu_{out} [pCi/L]
2.35	0.77	38075	6.17E-05	82.2%	0.149

Maximum Acceptable B-5 Inflow [cfs]: 2.35

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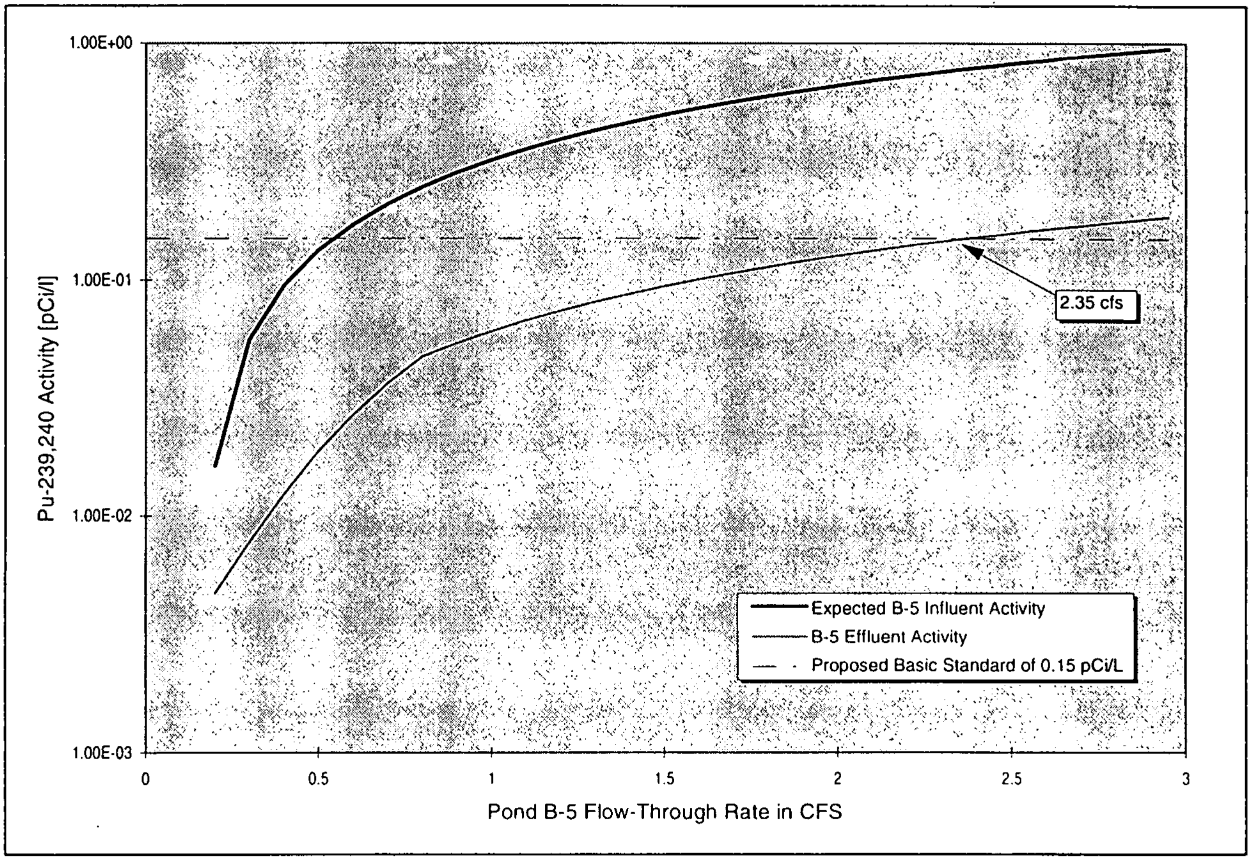

Figure 6-13. Water Quality Response for B-Series Ponds: Relationship Between Plutonium Activities and Flow Rates

6.3 CONTROLLED DETENTION MODEL SUMMARY

6.3.1 Key Assumptions

The following assumptions were made in developing the radionuclide removal model:

<u>Particle size distribution assumptions:</u>

- Adsorbed Pu is distributed among stormwater TSS particles based on available surface area for given particle sizes.
- Total suspended sediment particles are spherical.

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- The density of the suspended sediment particles is 2.2 g/cm^3. This assumption results in a more conservative, less rapid settling rate as it represents the lower density range for sediments composed of SiO_2.

Controlled Detention Attenuation Model assumptions:

- Site detention ponds (the Ponds) can be modeled as ideal settling basins.
- All TSS particles enter at the top (water surface) of the Ponds.
- All TSS particles must reach the sediment zone to be removed.
- Detention ponds remove stormwater TSS based on Hazen's surface load theory.
- Detention pond volumes remain constant for all modeled influent stormwater flows according to outlet elevations.
- There exists some minimum settling basin depth below which turbulence, diffusion, and local velocities may result in sediment resuspension.
- There exists some rate of stormwater inflow (and corresponding constituent load), for any given detention pond, such that the critical settling velocity is slow enough for TSS and associated actinide removal, that the CWQCC standard will be achieved.

6.3.2 Results

Controlled Detention Model

The controlled detention model results provide the operational criteria for suspending controlled discharge and transitioning to temporary batch-mode operations. These criteria are stream discharge measurements obtained from gaging stations SW093 and GS10, or other suitable upstream gaging stations, which measure stormwater inflows to Pond A-3 / A-4 and Pond B-5, respectively. The model results dictate the following maximum stream discharges for maintaining controlled detention.

- Maximum Acceptable Pond A-4 Inflow: 0.58 cfs (controlled at A-3 outlet)
- Maximum Acceptable Pond B-5 Inflow: 2.35 cfs
- C-2 is not currently planned to be operated in controlled detention for the reasons stated in Section 6.2.1.

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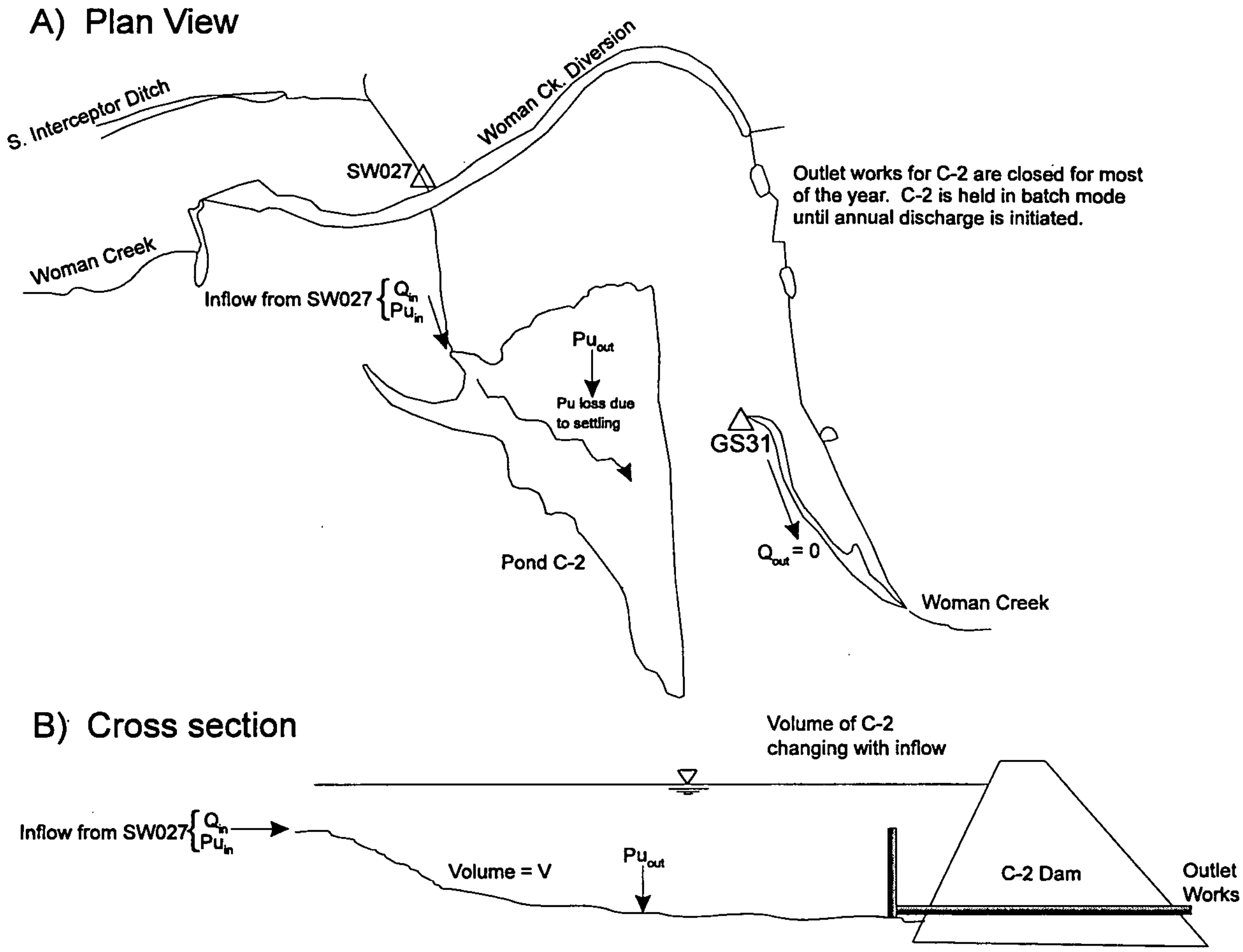
6.4 BATCH OPERATION ANALYSIS FOR SID / C-2 SYSTEM

6.4.1 Conceptual Model



6.4.2 Criteria for Batch Mode Settling

Because Pond C-2 will continue to be managed in batch-and-release mode, it is important to develop criteria for determining the optimum time of the year to discharge the pond. This will minimize the number of samples collected each year to determine Proposed Basic Standard attainment for Pu and Am prior to discharge.

The time trend for Pond C-2 Pu activities shown in Figure 6-14 indicates that Pu activity fluctuates seasonally. The data in Figure 6-14 show that Pu activity is at an annual minimum during winter months when ice covers the pond. This is likely due to no input of Pu load to Pond C-2 and no resuspension of pond bottom material (i.e.: no wave erosion) in winter months when both the SID and Pond C-2 are frozen or at least have ice cover.

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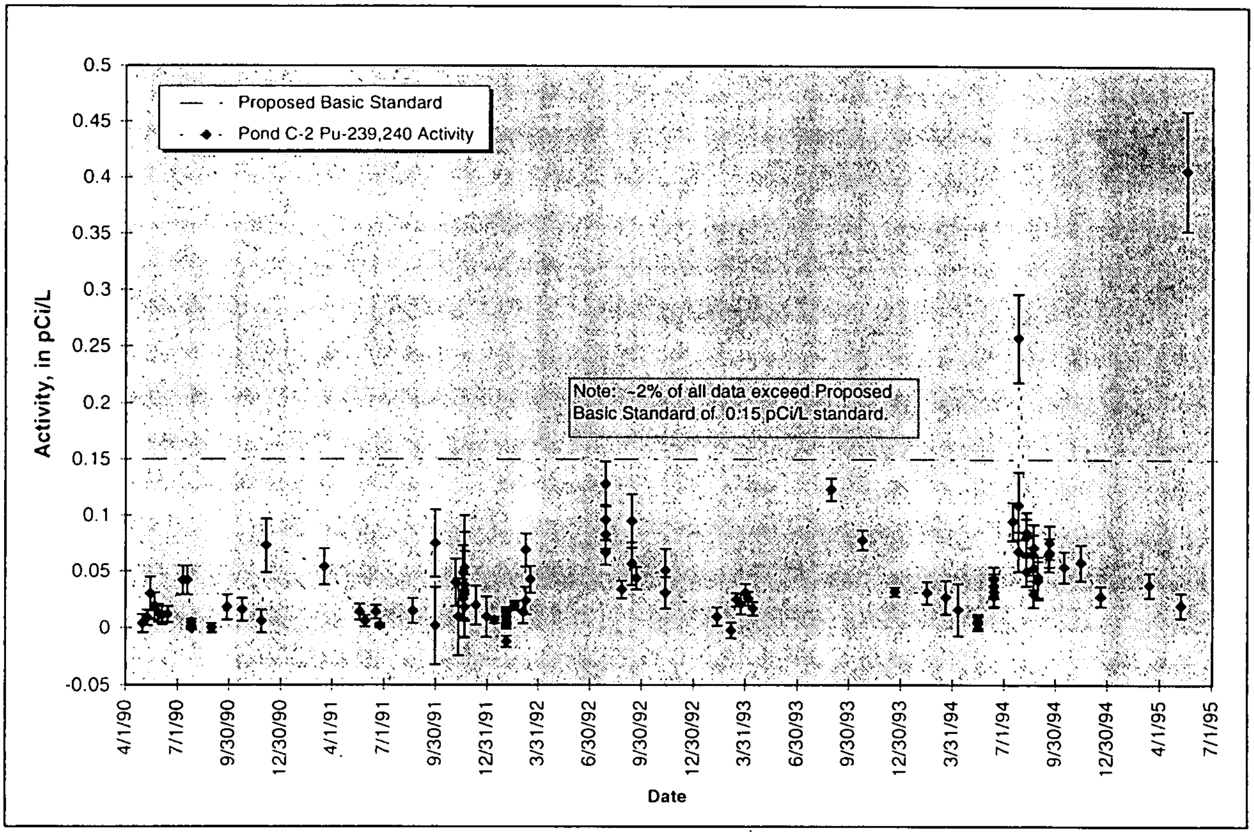

Figure 6-14. Variation of Pond C-2 Plutonium-239,240 Activity with Time

The data in Figure 6-15 through Figure 6-17 also indicate that discharge during summer months should be avoided because SID inflows contribute Pu load to the pond, and sediment resuspension mechanisms may aggravate efforts to achieve acceptable water quality for discharge during the summer months. The flow values in Figure 6-15 are not considered inaccurate, but are included for their relative magnitude. Water Year 1995 inflow data to pond C-2 shown in Figure 6-16 clearly indicate that the majority of the runoff to C-2 occurs during April, May, and June. This information further supports the recommended timing for Pond C-2 discharges described above. This discharge record was measured by the IA IM/IRA Surface Water Monitoring program and are considered accurate.

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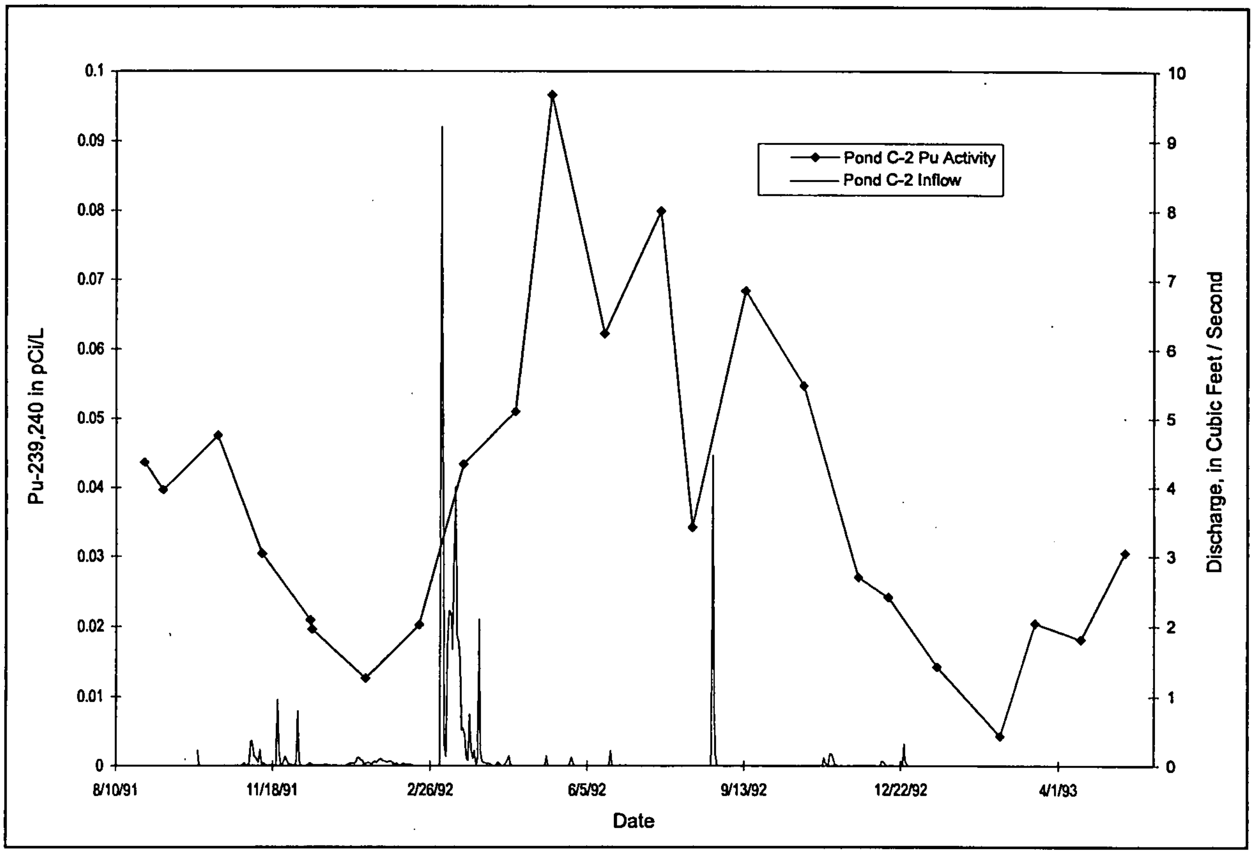

Pu data from: Los Alamos National Laboratory Characterization Study; flow data measured at gaging station SW027

Figure 6-15. Relationship Between Plutonium-239, 240 Activity and Stormwater Inflow for Pond C-2 by Date

Data in Figure 6-17 indicate that resuspension of Pu and exceedance of the Proposed Basic Standard might occur due to changing redox conditions in the pond; as indicated by simultaneous increases in dissolved manganese in Pond C-2. During summer months, Pond C-2 could become stagnant, causing decreased dissolved oxygen and, in turn, alter the redox state of manganese in the Pond C-2 bottom materials. If Pu is adsorped to a manganese oxide coating in the sediments, then liberation of the Pu might occur when the coating dissolves. Alternatively, wave erosion could resuspend the bottom materials which are both Pu and manganese containing; thus producing the simultaneous time trends shown in Figure 6-17. These hypotheses have not been tested or studied in Pond C-2, but the data indicate that these mechanisms are plausible. These mechanisms were proposed in 1992 by EG&G Surface Water and DOE (Dr. K.M. Motyl, Ph.D., RMRS, oral communication, 1995).

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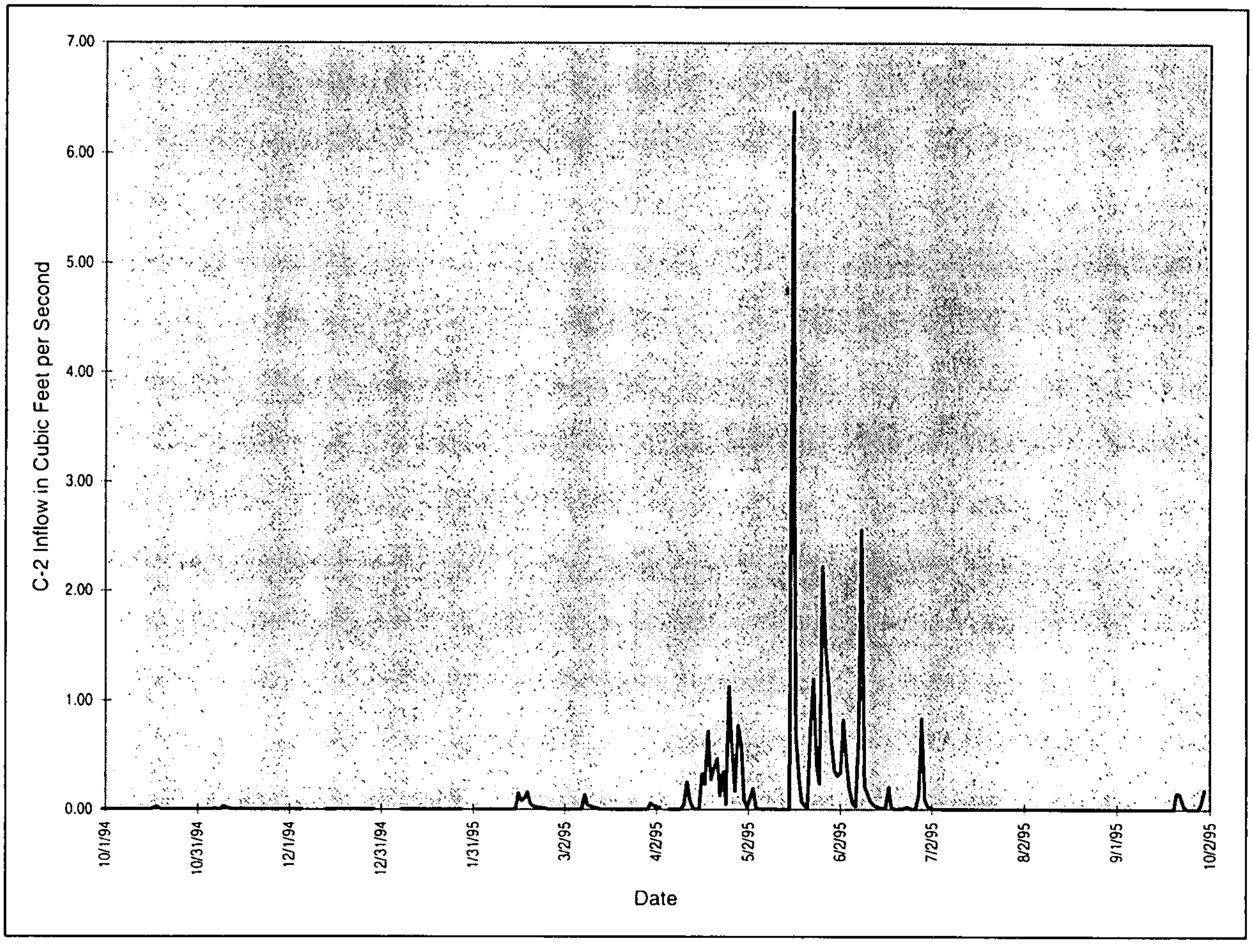

Figure 6-16. Mean Daily Inflow to Pond C-2 Measured at Gaging Station SW027: Water Year 1995.

The OU5 bottom sediment data (RMRS, August 1995) include one sample of Pond C-2 bottom sediment collected near the outlet works (Sample Number SD50002WC, November 5, 1992). The radiochemical data for this sample show a Pu activity of 1.6 pCi/g and an Am activity of 0.29 pCi/g. Based on these data, resuspension of 96 mg/L TSS might cause an excursion of Pu above the Proposed Basic Standard of 0.15 pCi/L.

The available data show that the optimum time for discharge of Pond C-2 is between late October through ice out; which could be as late as mid-April. When Pond C-2 has ice cover, the water column is not disturbed by wind or SID inflow. Therefore, Pond C-2 discharge during ice cover could be the optimum operating mode to ensure Proposed Basic Standard attainment. This does not preclude discharging during other seasons. Sampling and sample analysis will be used as the indicator for discharging Pond C-2, and discharge with Proposed Basic Standard attainment could be possible at any

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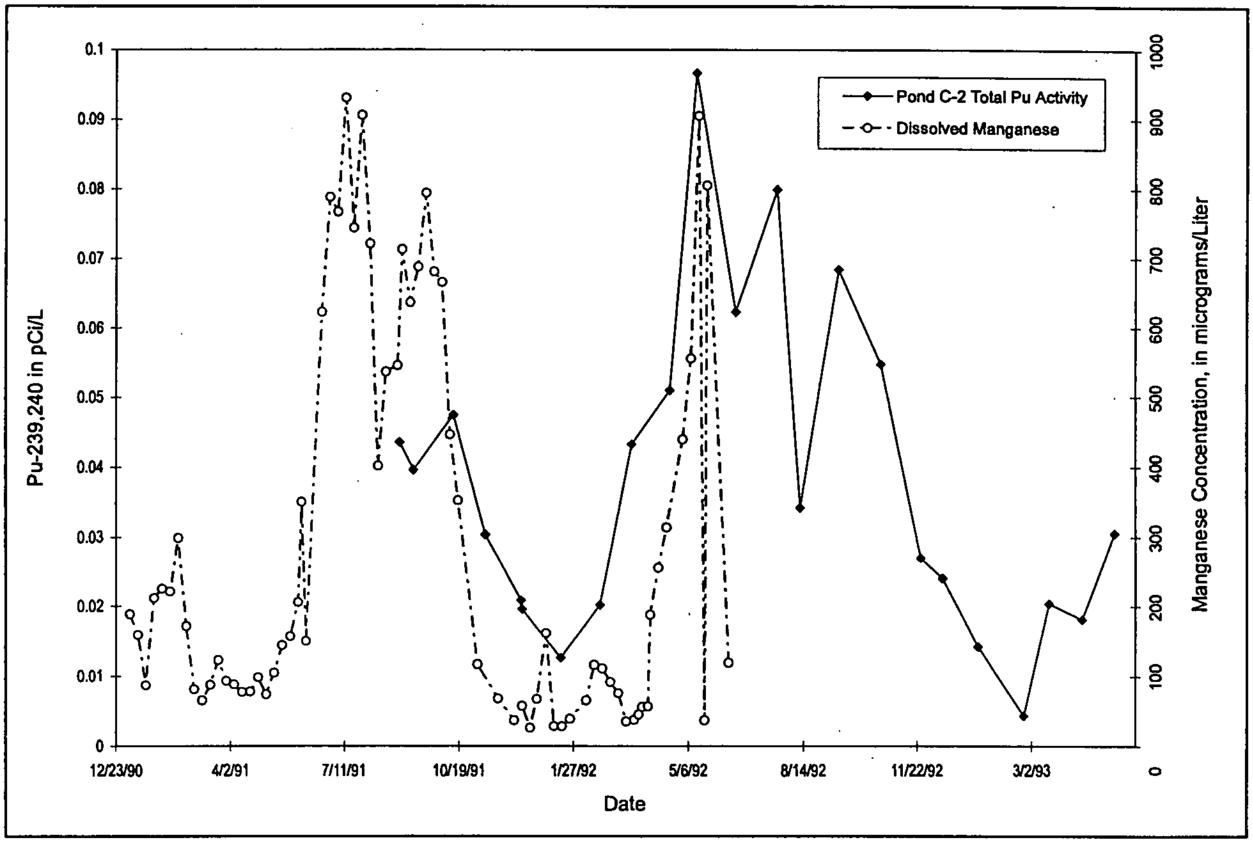
given time of the year. Exceedance of Pond C-2 Dam action levels that affect dam safety shall override discharge criteria based on Proposed Basic Standard attainment.



Pu data from: Los Alamos National Laboratory Characterization Study; Mn data from NPDES Compliance Monitoring;

Figure 6-17. Variation of Plutonium-239, 240 Activity and Dissolved Manganese Concentration with Time for Pond C-2

7. POND OPERATIONS CRITERIA / PROTOCOL

The numerical results presented in this section are based on the current operating parameters at the Site. These parameters include but are not limited to current environmental data, hydrologic / hydraulic conditions, water quality goals and standards, regulatory issues, funding issues, and constituent loads. It is expected that this document will be a dynamic document. Based on changes in the above parameters, pond operations may change accordingly after consultation between all concerned parties.

In order to effectively manage the detention ponds, information regarding the hydrologic conditions of the systems must be continuously measured. This measurement may be performed by personnel and/or the SSW telemetry system. Details regarding the implementation of system monitoring are yet to be determined. The following sections titled Monitoring Requirements and Assignments of Tasks provide a framework for monitoring to support management decision making.

Two organizations within RMRS, the SSW group and Liquid Waste Operations (LWO), are responsible for monitoring and operating the detention pond network. SSW is responsible for general oversight of pond operations. In addition, SSW is tasked with maintenance and operation of the flow monitoring equipment, the flow monitoring radio telemetry network, the controlled detention and pond operations computer models, and Pond A-4, B-5, and C-2 valve operations. LWO is responsible for A-3 gate operations as directed by SSW. Additionally, LWO is responsible for "off-hour" operations as outlined in this section. The LWO Control Room is operated 24 hours per day.

Details for Ponds A-3, A-4, B-5, and C-2 are contained in this Section. Sufficient detail on the operation of other Site ponds is contained in Section 5 of the Pond Operations Plan.

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7.1 PHASE I

Prerequisites and Assumptions—

- Installation of the A-4 outlet works upgrades must be completed prior to initiating Phase I.
- In the event that the proposed ITS Management Plan is agreed upon by the concerned parties, a pipeline from the ITS modular storage tanks to below A-3 will be completed during Phase I. ITS water will be diverted to Pond A-4 when pond water is available for assimilation of ITS water. Diversion of this ITS water necessitates continued pump transfer of Pond B-5 water to Pond A-4.

Tasks—

The following tasks need to be completed during Phase I in order to move on to Phase II of pond operations.

- Install pipeline from WWTP to Pond A-3 (current outfall to Pond B-3 to remain operational). Completion of this task allows for selective diversion of WWTP effluent to either B-3 (flow-through to B-5) or A-3. Selective diversion facilitates enhanced detention capacity, the de-watering of B-5 to construct the outlet works upgrades (can be accomplished using alternative methods), and subsequent batch (no WWTP inflow) and direct discharge of B-5.
- Complete upgrades to B-5 outlet works to allow for direct discharge through outlet works during Phase II.
- Obtain the 100 mg/L standard for NO_3^- in North Walnut Creek (NWC) if the ITS water diversion is ongoing. Attainment of this standard allows for the direct discharge of ITS water to NWC. With the ITS direct discharging to NWC, pump transfer of B-5 water to A-4 will no longer be required to assimilate ITS discharges. Therefore, B-5 can then be batch discharged directly to South Walnut Creek (SWC) using the upgraded outlet works.
- Pond C-2 outlet works may or may not be upgraded during this phase.

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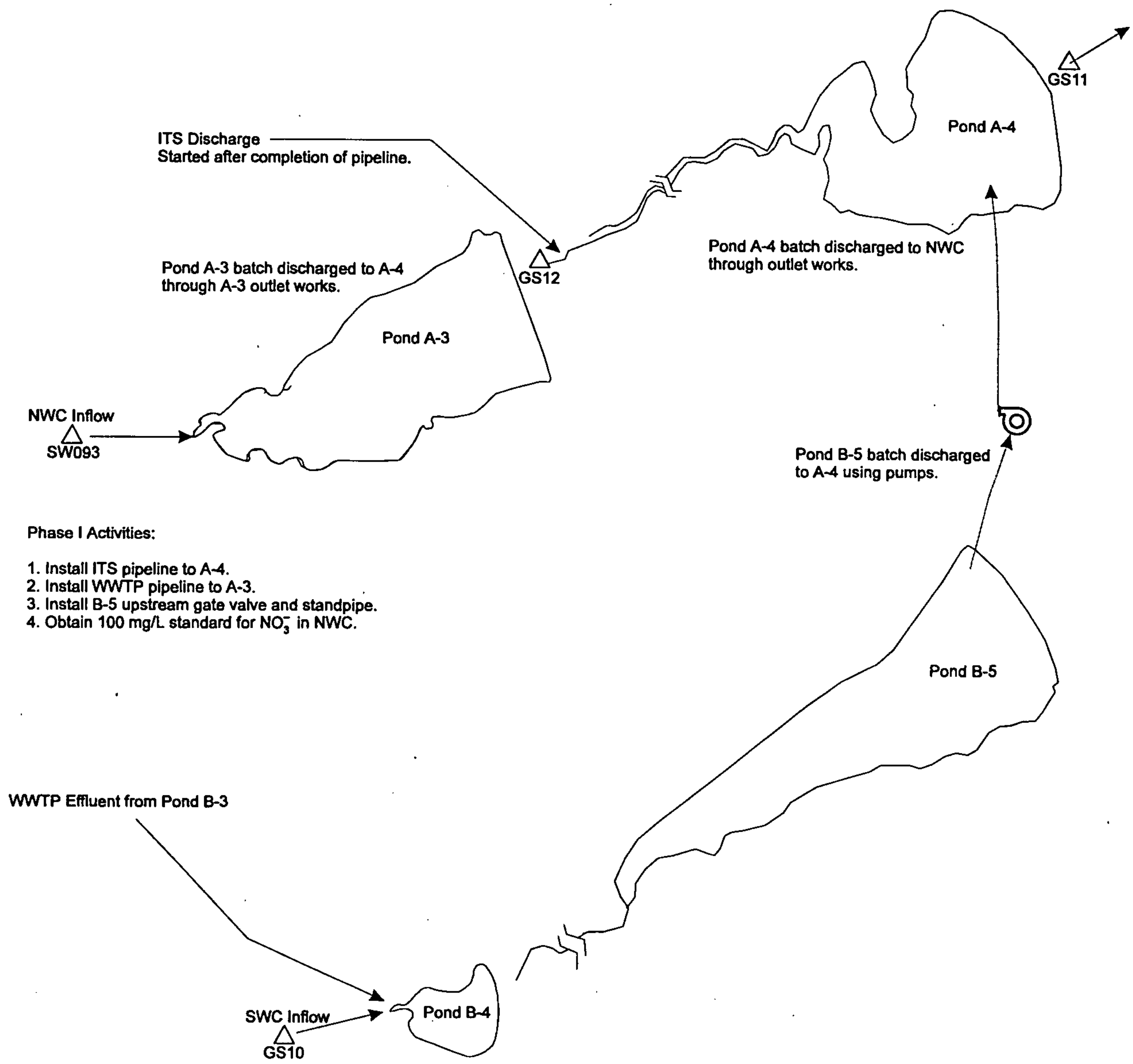

Figure 7-1. Conceptual Diagram of A- and B-Series Phase I Pond Operations.

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7.1.1 A-Series Ponds

Phase I operational logic for Ponds A-3 and A-4 is shown in Figure 7-2.

Phase I Operational Protocol

Pond A-3—

Pond A-3 will continue to batch discharge to Pond A-4 using the procedures used prior to Phase I. During Phase I, construction of the B-5 outlet works upgrades is expected to take place, and WWTP effluent will be diverted to A-3. This transfer will increase the number of batch discharges from A-3 to A-4, and A-3 will managed accordingly.

Pond A-4—

Pond A-4 will continue to batch discharge to Walnut Creek using procedures used prior to Phase I. However, discharge will occur through the recently completed outlet works. Decision support regarding discharge volumes to A-4 from B-5 and/or A-3 will be made with the aid of the SSW pond operations model.

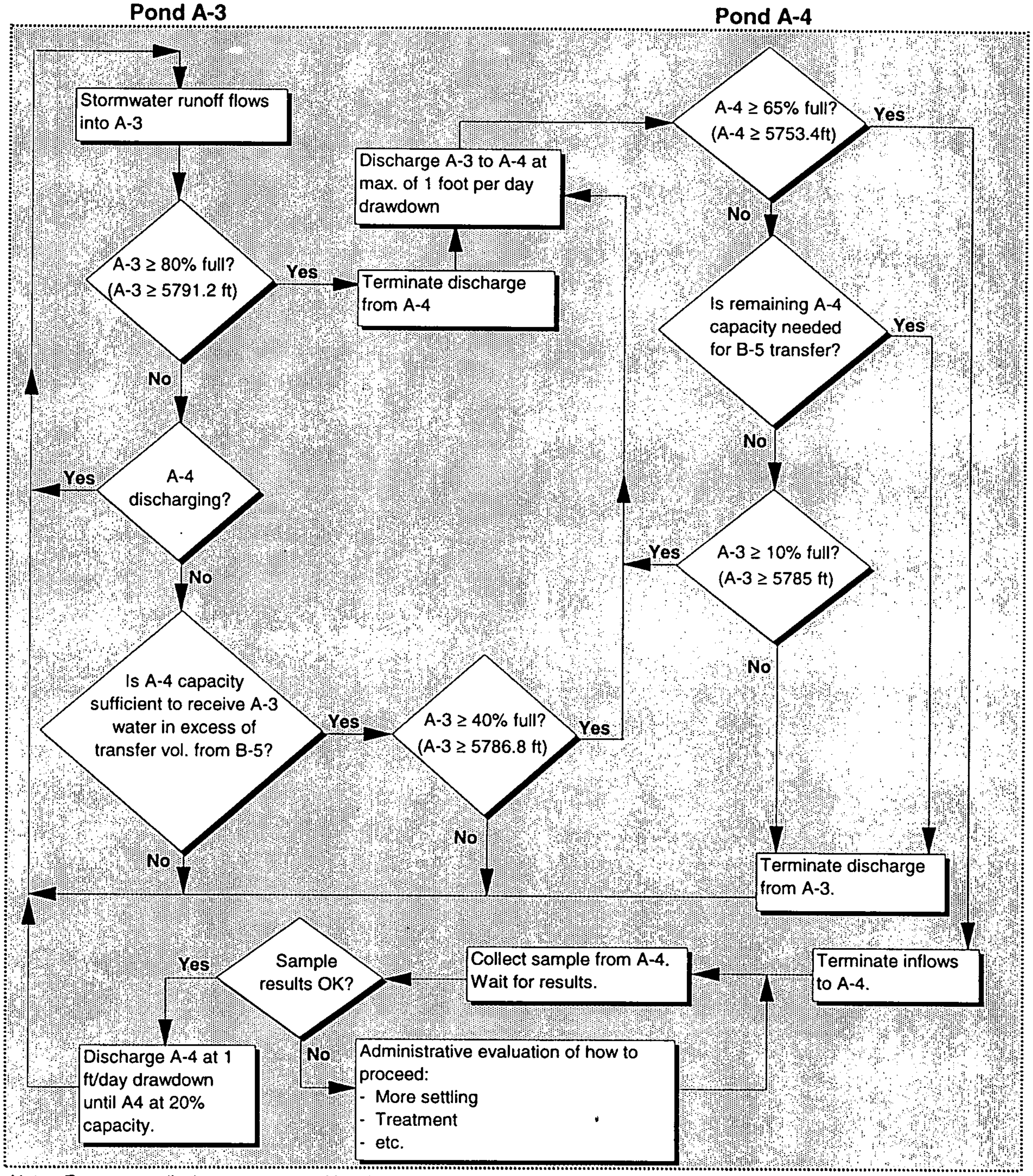
7.1.2 B-Series Ponds

Phase I operational logic for Pond B-5 is shown in Figure 7-3.

Phase I Operational Protocol

Pond B-5—

Pond B-5 will continue to be batch and pump transferred to Pond A-4. After the 100 mg/L NO_3^- standard for NWC is obtained or ITS discharges to A-4 are terminated, B-5 water will no longer be required in A-4 for ITS assimilation. However, B-5 will continue to be transferred to A-4 pending the upgrades to the B-5 outlet works and the initiation of Phase II.



Note: Emergency discharges prompted by elevated dam Action Levels take precedence over normal operational protocols.

Figure 7-2. A-Series Operation Flow Chart for Phase I.

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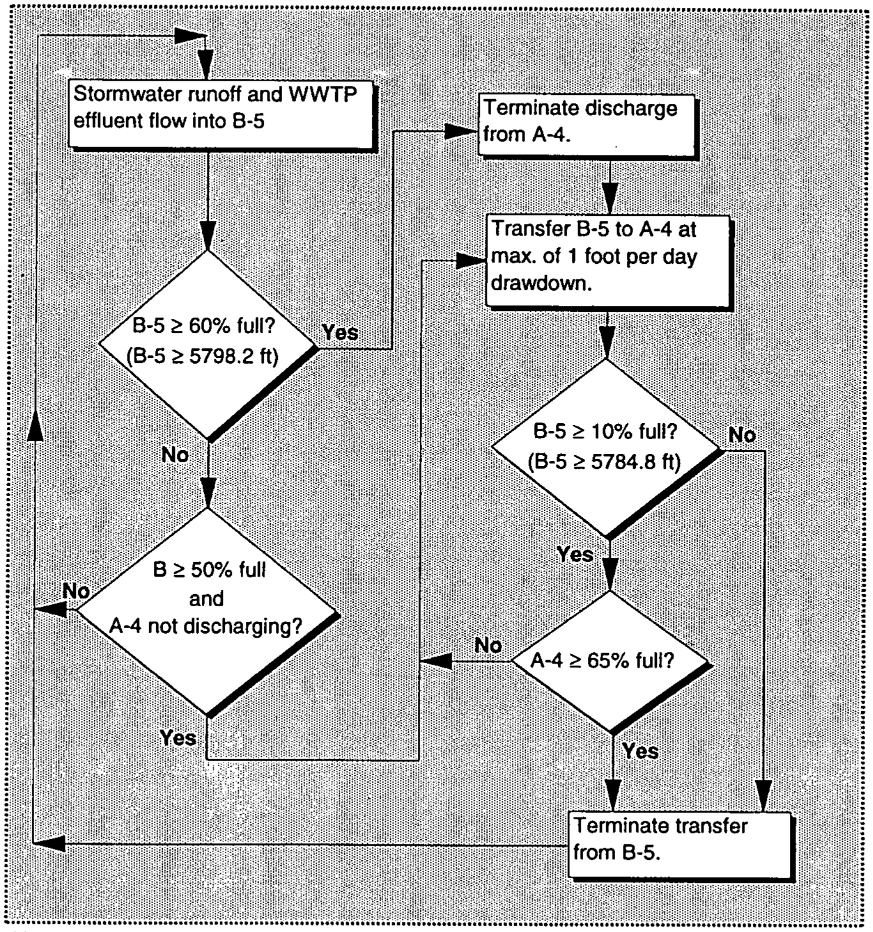

Note: Emergency discharges prompted by elevated dam Action Levels take precedence over normal operational protocols.

Figure 7-3. B-Series Operation Flow Chart for Phase I.

7.1.3 SID / C-2 System

Phase I operational logic for Pond C-2 is shown in Figure 7-4.

Phase I Operational Protocol

Controlled detention operation in the SID / C-2 System will not be employed due to the lack of sufficient data for the development of management tools, and the relatively small volumes of water involved (see Section 6.2); Pond C-2 typically requires a batch discharge only once per year. Operational pond level percentages were determined after consultation with SSW pond operations and civil engineering personnel.

Pending the possible development of controlled detention management tools for Pond C-2, C-2 will be continuously operated in batch mode. Criteria for Pond C-2 Phase I batch operations were determined in Section 6.4. Stormwater inflows will enter Pond C-2 continuously while discharges will be zero (outlet works closed). When the water level in Pond C-2 exceeds the 25% full level and/or the date at that time is after October 15th for the current year, and there are no stormwater inflows to C-2, then the batch discharge procedure will begin. October 15th was chosen because water quality in C-2 has historically been better at that time of year.

After sampling to confirm the satisfaction of the water quality discharge goals, C-2 will be discharged through the outlet works (or pump discharged pending completion of the outlet works upgrades) at a rate not to exceed a one foot per day drawdown rate until C-2 is 15% full or less. During discharge, if stormwater inflows to Pond C-2 are observed at gaging station SW027 (or other suitable gage), then discharge operations may be temporarily suspended. Determination on whether to terminate a batch discharge due to stormwater inflows will be made through consultation between Site personnel and the stakeholders. Monitoring data collected at SW027 under RFCA (e.g. turbidity, discharge volume) will be used to evaluate the significance of the inflow and support the termination decision. The SSW telemetry system would have the capability to directly control the C-2 discharge if some mechanical upgrades are made to the C-2 outlet works. Resumption of discharge may require additional sampling based on consultation with concerned parties and evaluation of any stormwater information that may have been collected. Evaluation of stormwater quality data collected in the future may allow for discharge of Pond C-2 even when C-2 is receiving stormwater inflows.

During batch-mode operation, if at any time the water levels in Pond C-2 exceed the 40% full level and stormwater inflows are zero, then the batch discharge procedure will initiate regardless of date. Batch discharge will occur as stated above.

If, during batch-mode, Pond C-2 reaches Dam Safety Action Level 4 or higher, based on pond elevation, piezometer measurements, and inspections of the dam, then C-2 will be immediately discharged at a maximum of one foot per day of drawdown. Water will be discharged regardless of quality. This is in accordance with the Site procedure, Emergency Response Plan for Failure of Dams A-4, B-5, or C-2 (EG&G, 1995c). The discharge will continue until Pond C-2 is returned to the 15% or less capacity level.

The operations logic for Pond C-2 is shown in Figure 7-4 on the following page.

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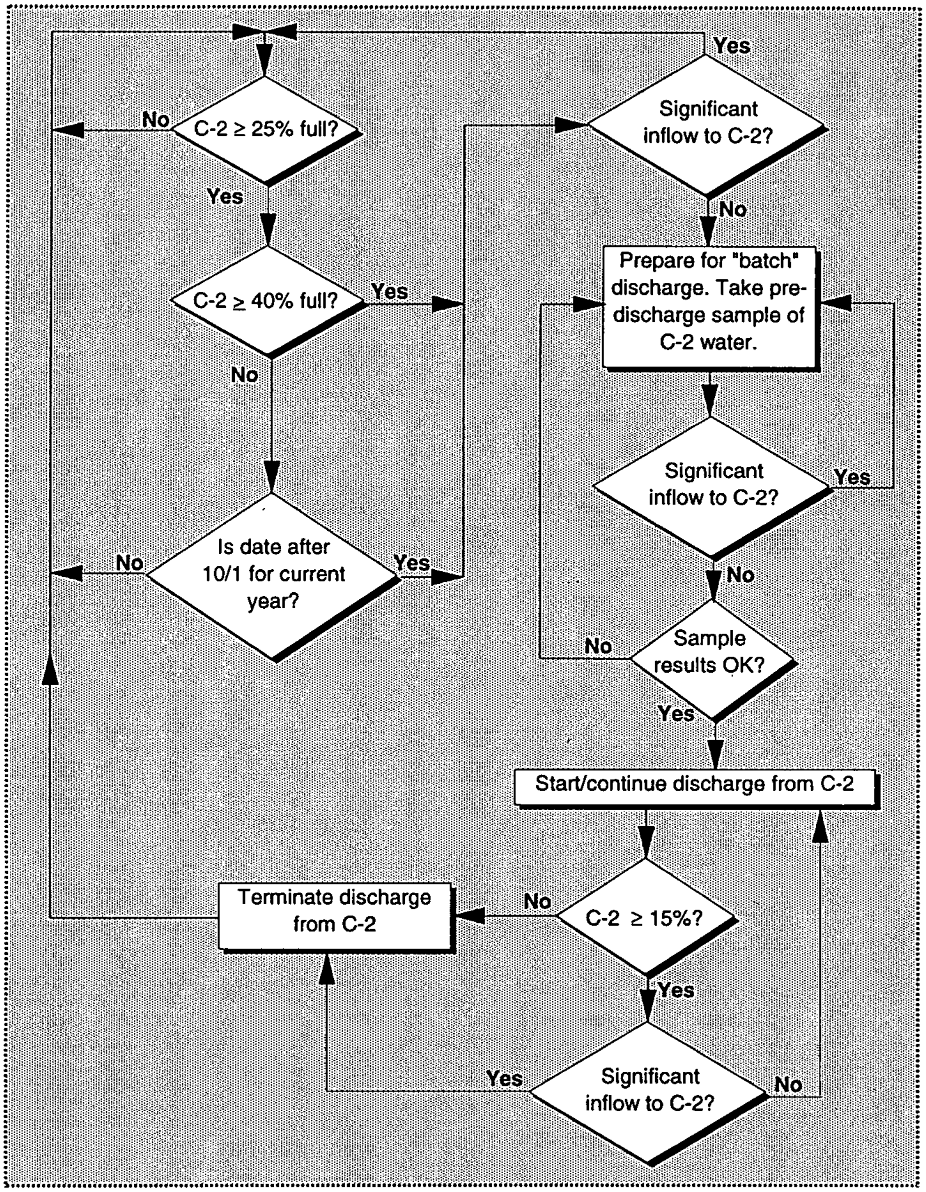

Notes:
- For detailed explanation of C-Series operations in Phase IV, see TA: Sections 7.4.
- Pond C-2 inflow rate monitored continuously.
- Emergency discharges prompted by elevated dam Action Levels take precedence over normal operational protocols.

Figure 7-4. Pond C-2 Operations Flow Chart for All Phases

7.1.4 Landfill Pond

Phase I Operational Protocol

Landfill Pond water is transferred in batch via pumping to Ponds A-1, A-2, or A-3 (in that order of preference) only when it fills to a level that causes dam safety concerns. Landfill Pond transfers to Pond A-2 generally occur only if Pond A-1 is close to being full (i.e., greater than 60%). In the event that water is pumped to the A-1 Bypass line and routed to Pond A-3, it becomes impounded for further analysis and eventual discharge (TA Reference: 9.1.3 and 9.2.2).

The Landfill Pond receives direct precipitation and runoff from an area, approximately 18 acres, encompassing the sanitary landfill. The pond also receives leachate flow from a seep located near the base of the east face of the landfill. The seep water contains FO39 hazardous waste and therefore should be handled as a hazardous waste. A passive seep collection and treatment system was designed to remove FO39 listed waste from the seep water. This seep and the proposed treatment system are described in Modified Proposed Action Memorandum Passive Seep Collection and Treatment Operable Unit No. 7 (RF/ER-95-0086.UN). Implementation of the interception and treatment system was implemented in late 1995. After final closure of the landfill has been completed, breaching of the Landfill Pond Dam will be considered.

7.1.5 Phase I Monitoring Requirements and Assignments of Tasks

Phase I pond operations will require field and telemetry monitoring of surface water inflows, pond discharges, pond elevations, and dam piezometer levels for management decision support. The proposed ITS Management Plan will contain additional monitoring requirements not detailed herein.

Table 7-1. Phase I Monitoring Specifications.

Parameter	Monitoring Location	Method	Organization	Potential Action
A-3 elevation	Pond A-3	telemetry, field inspection	SSW, LWO	initiate batch and discharge cycle; terminate A-4 discharge; initiate A-3 operations based on emergency procedures
A-3 piezometer levels	A-3 Dam	telemetry, field inspection	SSW	initiate A-3 operations based on emergency procedures
A-3 inflows	SW093	telemetry	SSW	general pond operations
A-3 outflows	GS12	telemetry, field inspection	SSW, LWO	adjust outflow rate to maintain 1 foot/day drawdown

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Table 7-1. Phase I Monitoring Specifications. (continued)

Parameter	Monitoring Location	Method	Assignment	Potential Action
A-4 elevation	Pond A-4	telemetry, field inspection	SSW, LWO	initiate batch and discharge cycle; terminate A-3 or B-5 inflows; initiate A-4 operations based on emergency procedures
A-4 piezometer levels	A-4 Dam	telemetry, field inspection	SSW	initiate A-4 operations based on emergency procedures
A-4 inflows	GS12, B-5 transfer line	telemetry, field inspection	SSW	general pond operations
A-4 outflows	GS11	telemetry, field inspection	SSW, LWO	adjust outflow rate to maintain 1 foot/day drawdown
B-5 elevation	Pond B-5	telemetry, field inspection	SSW, LWO	initiate B-5 to A-4 batch and transfer cycle; terminate B-5 discharge; initiate B-5 operations based on emergency procedures
B-5 piezometer levels	B-5 Dam	telemetry, field inspection	SSW	initiate B-5 operations based on emergency procedures
B-5 inflows	GS10, GS09, WWTP	telemetry, field inspection	SSW	general pond operations
B-5 outflows	B-5 transfer line	field inspection	SSW	adjust outflow rate to maintain 1 foot/day drawdown
C-2 elevation	Pond C-2	telemetry, field inspection	SSW	initiate batch and discharge cycle; initiate C-2 operations based on emergency procedures
C-2 piezometer levels	C-2 Dam	telemetry, field inspection	SSW	initiate C-2 operations based on emergency procedures
C-2 inflows	SW027	telemetry	SSW	initiate batch discharge procedures; suspend batch discharge procedures
C-2 outflows	GS31	telemetry	SSW	adjust outflow rate to maintain 1 foot/day drawdown
Landfill Pond elevation	Landfill Pond	field inspection	SSW	initiate transfer procedure; initiate Landfill Pond operations based on emergency procedures

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7.2 PHASE II

Prerequisites and Assumptions—

- Completion of the B-5 outlet works upgrades.
- In the event that the proposed ITS Management Plan is being implemented, the 100 mg/L NO_3^- standard for NWC will have been obtained and agreement on the direct discharge of the ITS to NWC will be achieved.
- The WWTP to Pond A-3 pipeline will be completed and operational.
- New Broomfield Water Treatment Plant is online.

Tasks—

The following tasks need to be completed during Phase II in order to move on to Phase III of pond operations.

- Pond C-2 outlet works will be upgraded prior to moving to Phase III operations for C-2.

7.2.1 A-Series Ponds

Phase II operational logic for Ponds A-3 and A-4 is shown in Figure 7-6.

Phase II Operational Protocol

Pond A-3—

Pond A-3 will be batch discharged to Pond A-4 on a weekly basis if the volume is greater than 15%. For each batch A-3, will be discharged to a 10% volume level. Once A-4 reaches a volume of 65%, inflows from A-3 will be terminated, and the WWTP effluent will be routed to Pond B-3. During a Pond A-4 discharge cycle, Pond A-3 will receive only stormwater runoff. Once A-4 has completed its discharge, the WWTP will be routed back to A-3, and A-3 will begin weekly batch discharges to A-4.

Pond A-4—

Pond A-4 will continue to batch discharge to Walnut Creek by the procedures used in Phase I. During Phase II, A-4 will not be receiving pumped transfers from B-5 provided that the ITS discharges are

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discontinued or direct discharged to NWC, and the B-5 outlet works upgrades are in place to facilitate direct B-5 discharge to SWC. A-4 will be batch discharged when the A-4 volume reaches 65%. Should the volume in A-3 reach 80% during an A-4 batch cycle, any A-4 discharge will be immediately terminated, and A-3 will be subsequently discharged to A-4.

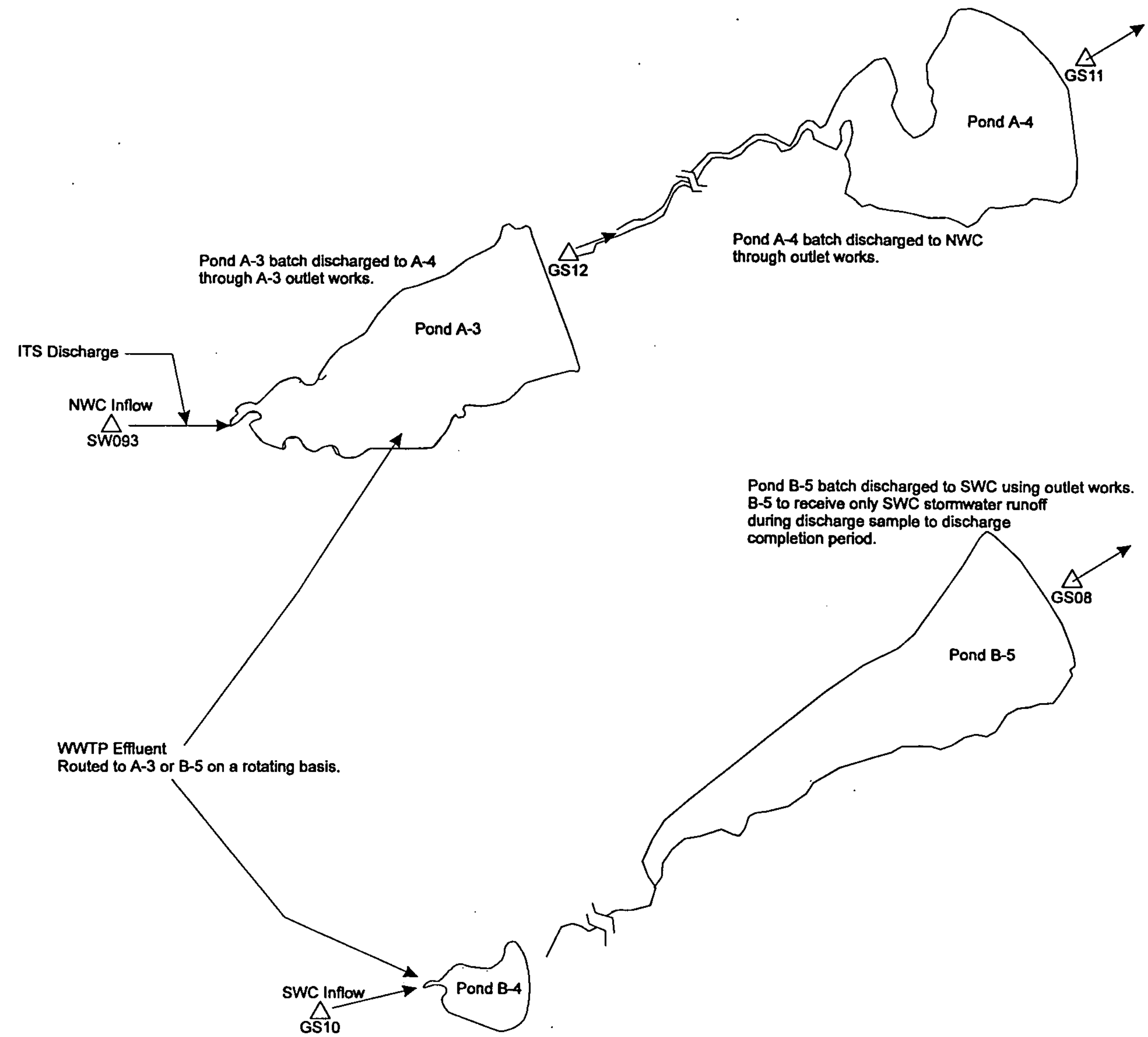

Figure 7-5. Conceptual Diagram of A- and B-Series Phase II Pond Operations.

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7.2.2 B-Series Ponds

Phase II operational logic for Pond B-5 is shown in Figure 7-6.

Phase II Operational Protocol

Pond B-5—

Pond B-5 will be batch and direct discharged to SWC using the recently completed outlet works. Once the 100 mg/L NO_3^- standard for NWC is obtained or ITS discharges to A-4 are terminated, B-5 water will no longer be required for ITS assimilation in A-4. During a batch cycle in Pond B-5, WWTP effluent will be diverted to A-3. Selective routing of WWTP effluent would allow B-5 to discharge while receiving periodic inflows consisting only of stormwater. If the WWTP effluent needs to be diverted to B-5 after initiation of a batch cycle for B-5 and if A-4 can not accept additional A-3 discharges as detailed above, then any discharge from B-5 will be terminated and a new B-5 batch cycle will be initiated. Should B-5 reach 50% at any time during an A-4 discharge cycle, the WWTP will be diverted to A-3, and the batch discharge cycle will begin for B-5.

7.2.3 SID / C-2 System

Phase II Operational Protocol

Phase II operating protocol for the SID / C-2 System are the same as for Phase I, detailed in Section 7.1.3.

7.2.4 Landfill Pond

Phase II Operational Protocol

Phase II operating protocol for the Landfill Pond are the same as for Phase I, detailed in Section 7.1.4.

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7.2.5 Phase II Monitoring Requirements and Assignments of Tasks

Phase II pond operations will require field and telemetry monitoring of surface water inflows, pond discharges, pond elevations, and dam piezometer levels for management decision support.

Table 7-2. Phase II Monitoring Specifications.

Parameter	Monitoring Location	Method	Organization	Potential Action
A-3 elevation	Pond A-3	telemetry, field inspection	SSW, LWO	initiate batch and discharge cycle; determine WWTP routing; terminate A-3 discharge; initiate A-3 operations based on emergency procedures
A-3 piezometer levels	A-3 Dam	telemetry, field inspection	SSW	initiate A-3 operations based on emergency procedures
A-3 inflows	SW093, WWTP	telemetry	SSW	general pond operations
A-3 outflows	GS12	telemetry, field inspection	SSW, LWO	adjust outflow rate to maintain 1 foot/day drawdown
A-4 elevation	Pond A-4	telemetry, field inspection	SSW, LWO	initiate batch and discharge cycle; terminate A-3 inflows, initiate A-4 operations based on emergency procedures
A-4 piezometer levels	A-4 Dam	telemetry, field inspection	SSW	initiate A-4 operations based on emergency procedures
A-4 inflows	GS12	telemetry, field inspection	SSW	general pond operations
A-4 outflows	GS11	telemetry, field inspection	SSW, LWO	adjust outflow rate to maintain 1 foot/day drawdown
B-5 elevation	Pond B-5	telemetry, field inspection	SSW, LWO	initiate batch and discharge cycle; divert WWTP inflows to A-3; initiate B-5 operations based on emergency procedures
B-5 piezometer levels	B-5 Dam	telemetry, field inspection	SSW	initiate B-5 operations based on emergency procedures
B-5 inflows	GS10, WWTP	telemetry, field inspection	SSW	general pond operations
B-5 outflows	B-5 transfer line	field inspection	SSW	adjust outflow rate to maintain 1 foot/day drawdown

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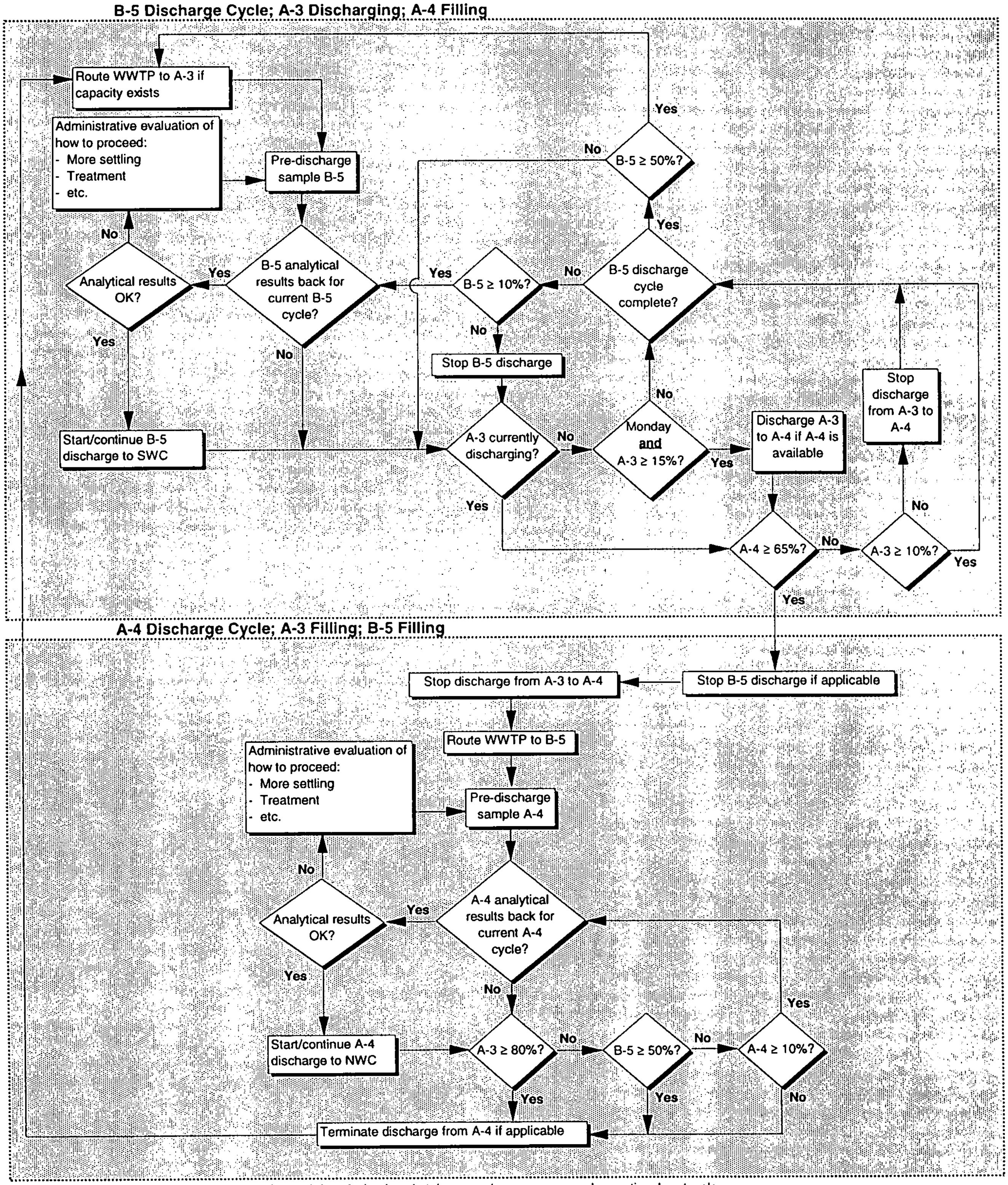

Note: Emergency discharges prompted by elevated dam Action Levels take precedence over normal operational protocols.

Figure 7-6. A- and B-Series Operation Flow Chart for Phase II.

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Table 7-2. Phase II Monitoring Specifications. (continued)

Parameter	Monitoring Location	Method	Assignment	Potential Action
C-2 elevation	Pond C-2	telemetry, field inspection	SSW	initiate batch and discharge cycle; initiate C-2 operations based on emergency procedures
C-2 piezometer levels	C-2 Dam	telemetry, field inspection	SSW	initiate C-2 operations based on emergency procedures
C-2 inflows	SW027	telemetry	SSW	initiate batch discharge procedures; suspend batch discharge procedures
C-2 outflows	GS31	telemetry	SSW	adjust outflow rate to maintain 1 foot/day drawdown
Landfill Pond elevation	Landfill Pond	field inspection	SSW	initiate transfer procedure; initiate Landfill Pond operations based on emergency procedures

7.3 PHASE III

Prerequisites and Assumptions—

- Completion of the C-2 outlet works upgrades.
- Concerned parties agree to use controlled detention operations based on Site conditions and operations at that time.

Tasks—

Tasks needed to be completed during Phase III in order to move on to Phase IV are undefined at this time.

7.3.1 A-Series Ponds

Phase III operational logic for Ponds A-3 and A-4 is shown in Figure 7-8.

Phase III Operational Protocol

Controlled Detention Operation—

During routine controlled detention operation in the A-Series ponds, Pond A-4 will be utilized as a settling basin with a constant pool elevation, or volume, of 20% capacity and a steady-state inflow and outflow of no more than 0.58 cfs. This flow rate was determined by the analysis described in Section 6.2. During Phase III, WWTP effluent will be routed to either Pond A-3 or B-5 depending on existing pond capacities.

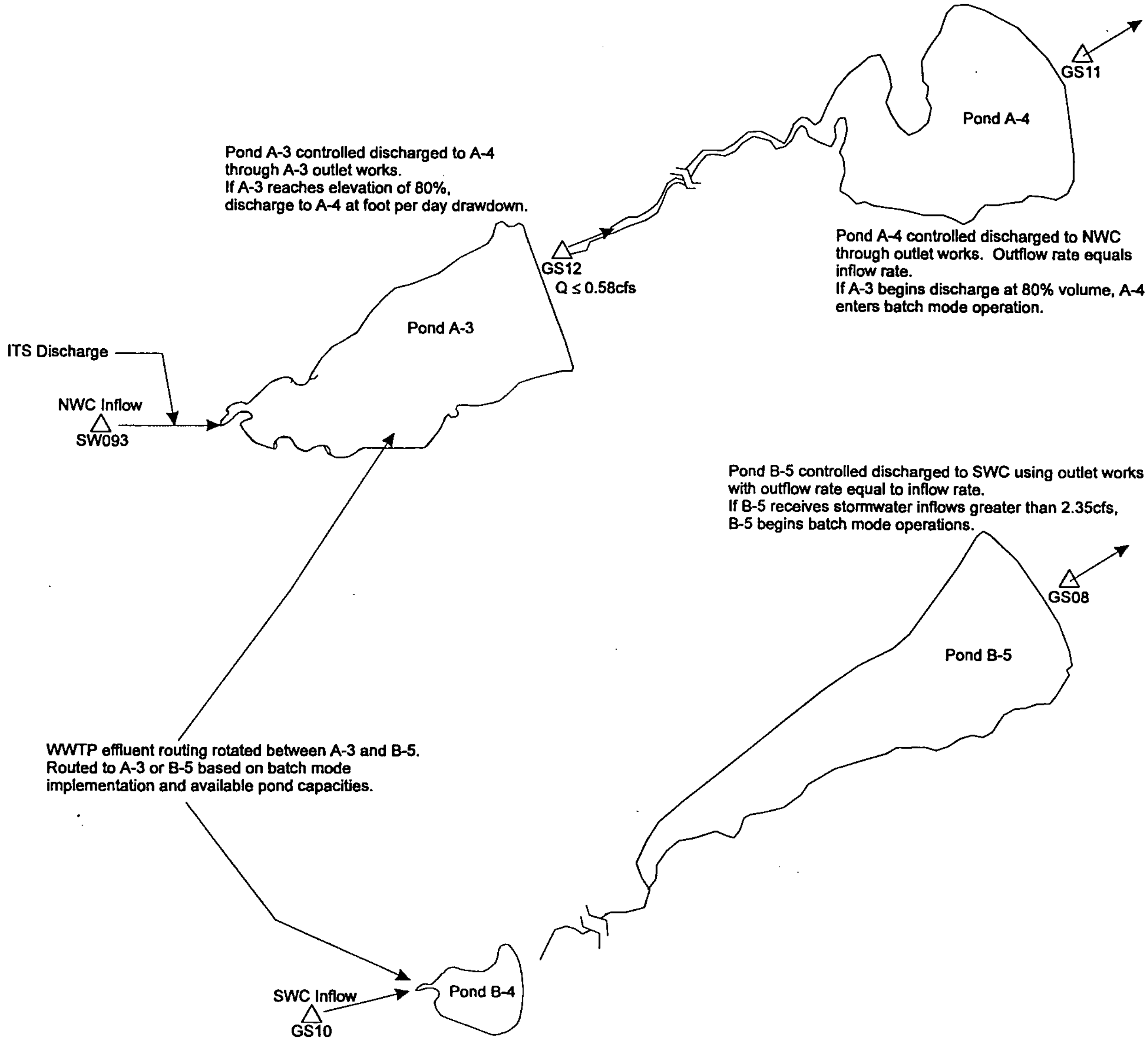

Figure 7-7. Conceptual Diagram of A- and B-Series Phase III Pond Operations.

The constant inflow to Pond A-4 will be controlled by manually adjusting the valve in the outlet works of Pond A-3 or through the use of a self-regulating flow control mechanism. The SSW telemetry system has the capability to directly control the A-3 discharge rate if some mechanical upgrades are made to the A-3 outlet works. Although flow rates into Pond A-3 will vary with storm events and intermittent WWTP inflows, this fluctuating inflow will be attenuated by Pond A-3 and released into Pond A-4 at a constant rate. A dropbox in Pond A-4, with an inlet at the 20% capacity level, will cause all outflows to be equal to the inflows (the outlet works can convey the 0.58 cfs with no change to A-4 pond levels). Consequently, while the Pond A-4 elevation will remain constant, the Pond A-3 level will rise and fall with fluctuating inflows. If inflow to Pond A-3 is zero and the pool elevation drops to the 10% capacity level, then the Pond A-3 discharge will be temporarily halted to prevent Pond A-3 from drying up and exposing sediments (A-3 will not have a standpipe). As soon as stormwater flow into Pond A-3 resumes, then the controlled discharge from Pond A-3 to A-4 would resume.

The only condition when a controlled detention mode would not be used is when large volumes of stormwater runoff cause Pond A-3 to fill to 80% of capacity - a level too high for safe dam operation. At this level, Pond A-3 would need to be discharged to A-4 at a drawdown rate equal to one foot per day to reduce the A-3 elevation to acceptable levels. Discharge rates during this operation would exceed the 0.58 cfs rate required for efficient controlled detention operations. To ensure water quality, the A-Series system would need to be switched into batch-mode, as discussed in the following section. For most years, A-3 is expected to be able to attenuate stormwater inflows without reaching the 80% level, and controlled detention operations will be continuous. Based on past hydrologic records, batch-mode operation for the A-Series ponds would not likely have been necessary during 1993, 1994, or 1996. However, batch mode would have been needed during the unusually wet spring of 1995.

Temporary Batch Mode Operation—

When Pond A-3 reaches a status of 80% full, the A-Series ponds will be switched into batch-mode operation. The outlet works for Pond A-4 will be closed and the Pond A-3 outlet works will be opened further to release water into Pond A-4 at a rate (greater than 0.58 cfs) that will draw down the Pond A-3 level a maximum of one foot per day.

Pond A-4 will be filled to a maximum of 65% while Pond A-3 will be prevented from dropping below the 10 % full status during this period. After the release from Pond A-3 into A-4 has been completed (A-4 is isolated at ~65%, and A-3 is at a minimum of 10%), water quality samples will collected from Pond A-4. If sample results indicate water quality standards are achieved, water will be released from Pond A-4 at a rate that will draw down the Pond A-4 level a maximum of one foot per day. When Pond A-4 is restored to a 20 % full status, the Pond A-3 outlet works will again be opened to flow at 0.58 cfs and controlled detention operations will resume.

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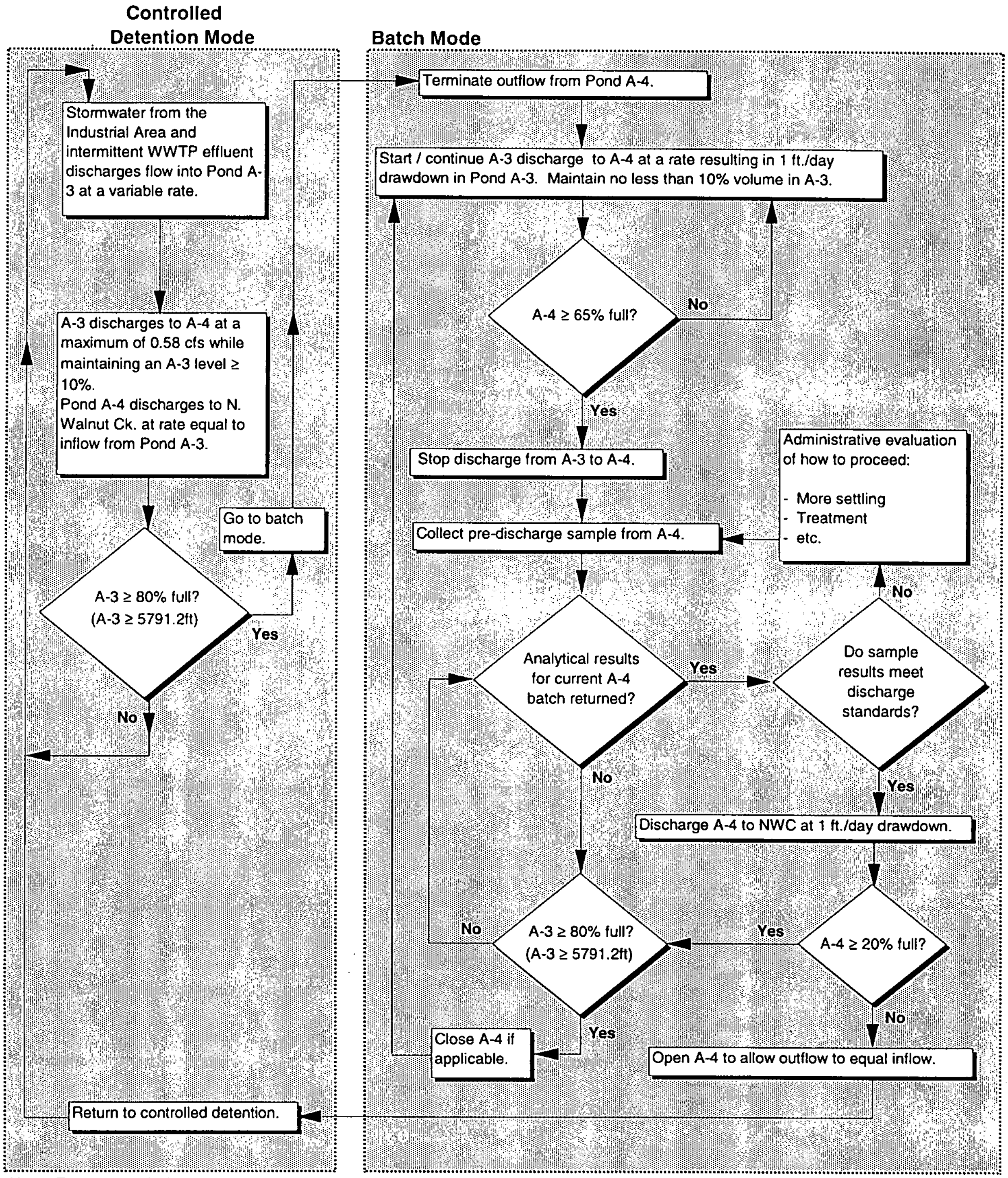

Note: Emergency discharges prompted by elevated dam Action Levels take precedence over discharge rates generated by controlled detention and batch mode models. During this phase, WWTP effluent with be diverted to either A-3 or B-5 based on existing pond capacities.

Figure 7-8. A-Series Operations Flow Chart for Phase III.

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7.3.2 B-Series Ponds

Phase III operational logic for Pond B-5 is shown in Figure 7-9.

Phase III Operational Protocol

Controlled Detention Operation—

Controlled detention operation in the B-Series ponds resembles the A-Series in the respect that the inflows and outflows for Pond B-5 will be at equilibrium. Controlled detention operations will occur when stormwater inflows to B-5 are between 0.0 and 2.35 cfs (the B-5 outlet works are open enough to handle 2.35 cfs and B-5 volume equilibrium is maintained for these small flow rates). When the inflow to Pond B-5 exceeds 2.35 cfs, Pond B-5 will be switched into batch-mode operation. This inflow rate was determined by the analysis described in Section 6.2.

Although the maximum allowable flow rate for controlled detention in the B-Series is higher than that of the A-Series, 2.35 cfs versus 0.58 cfs, respectively, the B-Series is more likely to be forced into batch-mode from storm events than the A-Series. This is because the A-Series has Pond A-3 to attenuate upstream flows and release water at a controlled rate into Pond A-4. The B-Series, in contrast, has no pond upstream of Pond B-5 with the capability of controlling stormwater inflows.

Temporary Batch Mode Operation

When the inflow to Pond B-5, as measured at gaging station GS10 (or any suitable upstream gaging station), exceeds 2.35 cfs, B-5 will be switched into batch-mode operation by closing the outlet works. When the B-5 volume reaches 40%, a B-5 pre-discharge water quality sample will be taken. While waiting for analytical results to be returned, the B-5 inflow rate will be continuously monitored. If the inflow rate exceeds 2.35 cfs at any time, a new pre-discharge sample will be taken and the batch cycle will be reinitiated. When analytical results indicate water quality standards are achieved, water will be discharged at a flow rate to drawdown Pond B-5 at a rate not exceeding one foot per day.

During a Pond B-5 discharge, stormwater inflow rates will be continuously monitored. If inflow rates exceed 2.35 cfs at any time during the discharge, then the discharge will be terminated and the B-5 batch cycle will be reinitiated. When B-5 reaches a volume of 10% during a batch discharge, controlled detention will resume.

In all cases, emergency water releases made necessary by dam safety factors will have priority over discharge rates established by model results.

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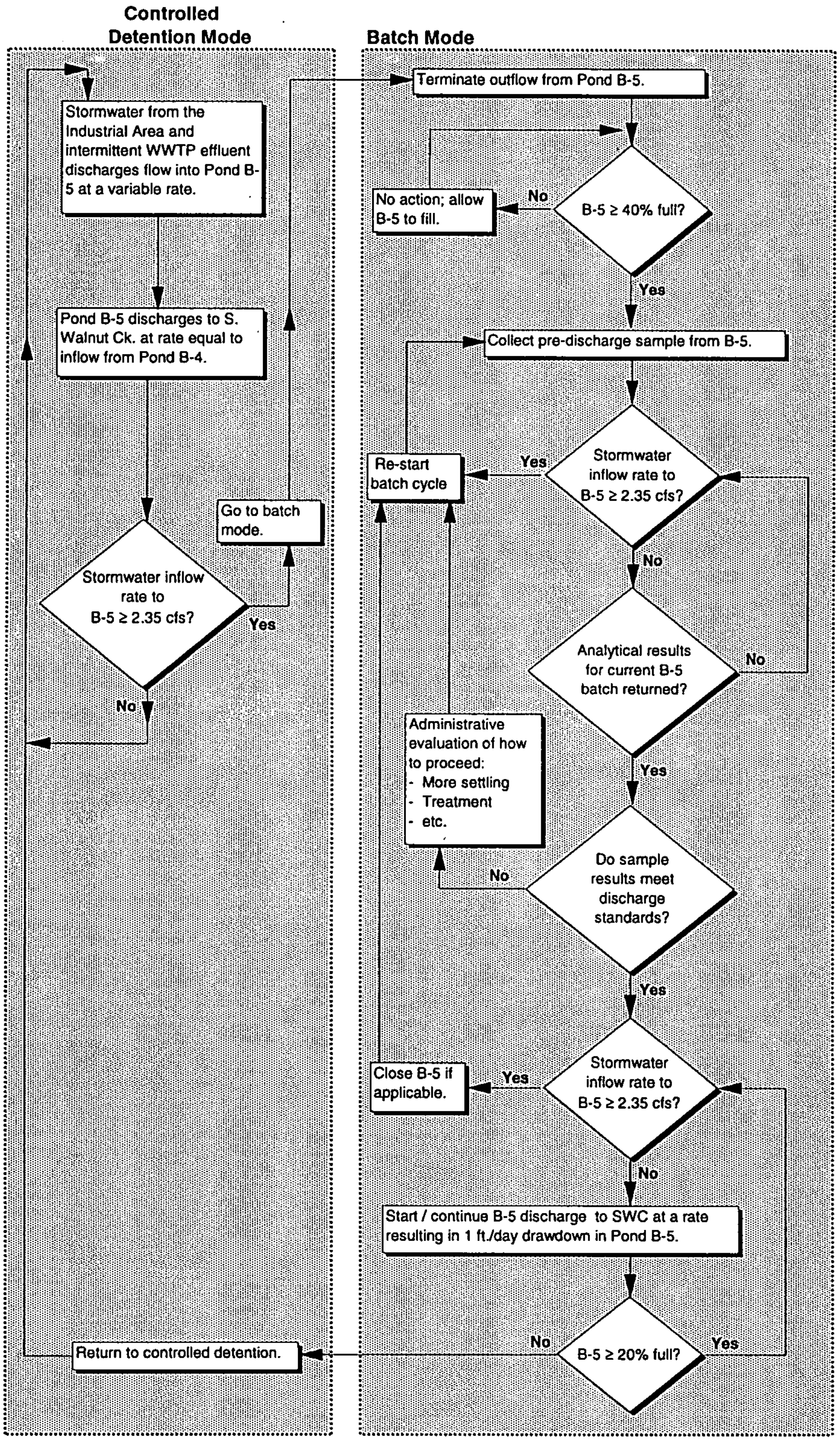

Note: Emergency discharges prompted by elevated dam Action Levels take precedence over discharge rates generated by controlled detention and batch mode models. During this phase, WWTP effluent with be diverted to either A-3 or B-5 based on existing pond capacities.

Figure 7-9. B-Series Operations Flow Chart for Phase III.

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7.3.3 SID / C-2 System

Phase III Operational Protocol

Phase III operating protocol for the SID / C-2 System are the same as for Phase I, detailed in Section 7.1.3. However, upgrades to the outlet works may be complete by this time, and C-2 could then be direct discharged to Woman Creek using the upgraded outlet works.

7.3.4 Landfill Pond

Phase III Operational Protocol

Phase III operating protocol for the Landfill Pond are the same as for Phase I, detailed in Section 7.1.4.

7.3.5 Phase III Monitoring Requirements and Assignments of Tasks

Phase III pond operations will require field and telemetry monitoring of surface water inflows, pond discharges, pond elevations, and dam piezometer levels for management decision support.

Table 7-3. Phase III Monitoring Specifications.

Parameter	Monitoring Location	Method	Assignment	Potential Action
A-3 elevation	Pond A-3	telemetry, field inspection	SSW, LWO	initiate batch and discharge cycle; divert WWTP to B-5 or A-3; terminate A-3 discharge; initiate A-3 operations based on emergency procedures
A-3 piezometer levels	A-3 Dam	telemetry, field inspection	SSW	initiate A-3 operations based on emergency procedures
A-3 inflows	SW093, WWTP	telemetry	SSW	general pond operations
A-3 outflows	GS12	telemetry, field inspection	SSW, LWO	adjust outflow rate to maintain flow of 0.58 cfs or less to A-4
A-4 elevation	Pond A-4	telemetry, field inspection	SSW, LWO	terminate A-3 inflows; initiate A-4 batch discharge; divert WWTP effluent to A-3 or B-5; return to controlled detention; initiate A-4 operations based on emergency procedures
A-4 piezometer levels	A-4 Dam	telemetry, field inspection	SSW	initiate A-4 operations based on emergency procedures
A-4 outflows	GS11	telemetry, field inspection	SSW, LWO	adjust outflow rate to maintain 1 foot/day drawdown during batch operations

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Table 7-3. Phase III Monitoring Specifications. (continued)

Parameter	Monitoring Location	Method	Assignment	Potential Action
B-5 elevation	Pond B-5	telemetry, field inspection	SSW, LWO	initiate batch discharge; divert WWTP inflows to A-3 or B-5; return to controlled detention; initiate B-5 operations based on emergency procedures
B-5 piezometer levels	B-5 Dam	telemetry, field inspection	SSW	initiate B-5 operations based on emergency procedures
B-5 inflows	GS10, WWTP	telemetry, field inspection	SSW	switch B-5 from controlled detention to batch cycling; reinitiate batch cycle for B-5
B-5 outflows	B-5 transfer line	field inspection	SSW	adjust outflow rate to maintain discharges as specified by inflows
C-2 elevation	Pond C-2	telemetry, field inspection	SSW	initiate batch and discharge cycle; initiate C-2 operations based on emergency procedures
C-2 piezometer levels	C-2 Dam	telemetry, field inspection	SSW	initiate C-2 operations based on emergency procedures
C-2 inflows	SW027	telemetry	SSW	initiate batch discharge procedures; suspend batch discharge procedures
C-2 outflows	GS31	telemetry	SSW	adjust outflow rate to maintain 1 foot/day drawdown
Landfill Pond elevation	Landfill Pond	field inspection	SSW	initiate transfer procedure; initiate Landfill Pond operations based on emergency procedures

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8. CONTINGENCY POND OPERATIONS

This section provides a discussion of responses for three main concerns related to off-normal conditions potentially encountered with operation of the Site pond network. These concerns are:

- Dam safety
- Spill response
- Options for water treatment

8.1 DAM SAFETY: ACTION LEVELS AND RESPONSE MEASURES

Emergency response actions related to the structural integrity of the Site terminal detention are addressed in Site procedure 1-A25-5500-06.08, Emergency Response Plan for Failure of Dams A-4, B-5, or C-2. This procedure defines six action levels for categorizing conditions up to and including dam failure.

This procedure implements requirements of DOE Order 5500.3A, Planning and Preparedness for Operational Emergencies, and is in consonance with the Federal Energy Regulatory Commission (FERC). The procedure also conforms to guidance outlined by the Colorado State Engineer's Office, Division of Water Resources.

The procedure applies to all Site contractor, subcontractor and DOE, RFFO employees who are tasked to become involved in emergency response actions affecting the three terminal ponds A-4, B-5 and C-2. The procedure addresses action levels and responses used in mitigating actual or potential dam failures and releases (including emergency discharges) from terminal detention ponds. The following list identifies possible emergency situations.

- Overflow of a detention dam spillway
- Normal seepage through dam that exceeds established safety levels
- Abnormal seepage or abnormal piezometer response
- Partial dam failure
- Catastrophic failure of a dam
- Other conditions which may indicate an emergency situation

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For potential dam failures and releases from interior detention ponds and the Landfill Dam, the Site Dam Response Team will determine an appropriate action level response from routine dam inspections, measurements of stream inflows to the dams, dam piezometer measurements, and modeling calculations. The Dam Response Team is composed of several RMRS personnel, one KH engineer, and field subcontractor personnel.

The reader is referred to the procedure which is Appendix A to the POP for more detailed information on emergency response protocol.

8.2 POND OPERATIONS AND SPILL RESPONSE

Spills to the environment at the Site are initially responded to by the Site HazMat Team. If upstream containment measures were unsuccessful and a contaminant spill was to reach the pond system, then water would be rerouted in accordance with the Site procedure, Containment of Spills Within Rocky Flats Drainages (1-C90-APR-SW.03). A detailed discussion of Site spill response organizations and measures is contained in Section 3 of this Technical Appendix.

8.3 POND WATER TREATMENT OPTIONS

Water treatment thresholds have not been established between DOE and the regulatory community. In all likelihood, water treatment will only be required during emergency conditions, in which case thresholds would be negotiated between DOE and stakeholders based on the special conditions of a given situation.

The report, Technology Assessment for Radionuclide Removal (TARR), (Write Water Engineers, Inc., 1994) was completed to: 1) document the performance of current technologies used to remove radionuclides from water; 2) evaluate performance tests on potential emerging technologies; and 3) identify information needs in radionuclide treatment technology. A more specific goal of the report was to identify and select treatment technologies capable of achieving an effluent concentration of 0.05 pCi/L for plutonium and americium, 5 pCi/L for uranium and gross Beta, and 7 pCi/L for gross alpha. The TARR determined that technologies for removal of uranium, gross alpha, and gross Beta to these stringent levels are available, but technologies for plutonium and americium removal were unproven on a full-scale basis. The technologies recommended for removal of mixed radionuclides included coagulation-precipitation or sand/multimedia filtration followed by ion exchange, reverse osmosis (RO), or submicron ultrafiltration (UF). Because the stringent discharge regulations also include many organic and inorganic constituents, physical separation removal technologies were emphasized rather than chemical treatment methods.

A pilot test was performed and reported (Particle Count Monitoring of Reverse Osmosis Water Treatment for Removal of Low-level Radionuclides (EG&G, 1995e)) which determined the performance of staged prefiltration, UF, and RO to treat raw A-4 pond water. The excellent performance

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demonstrated by the RO system would make it the technology of choice if pond water treatment were necessary. However, recent Site plans to decommission the Building 374 Waste System Evaporator during FY96 would eliminate RO from further consideration due to the inability to treat the significant volume of secondary liquid waste generated by this treatment method. Ion exchange, another technology recommended in the TARR, is also unacceptable due to similar requirements for liquid wastes produced during media regeneration. Therefore, physical separation by filtration (without chemical addition) remains as the technology recommended if treatment of pond water becomes necessary to meet the Site radionuclide discharge requirements.

Two filtration pilot tests were conducted by Surface Water personnel during the period of 1992-94. The first test report, Filter Bag Filtration Field Studies at Pond C-2 (EG&G, 1993c), reported the following results for filtration of raw Pond C-2 water with staged 10μm and 0.5μm absolutely-rated polypropylene filter bags.

- The filter bags reduced TSS by 78% and turbidity by 60%.
- A 50% reduction in total particle counts in the range of 1-150μm corresponded to a 30% reduction in Pu activity in the filtered effluent.
- Filter tanks with improved media-to-tank sealing surfaces were recommended to minimize bypass effects.

The second test report Water Treatment Cartridge Filter Pilot Test at Pond C-2 (EG&G, 1993d) reported results for filtration of raw C-2 pond water with disposable 2μm absolutely-rated polypropylene cartridges. Results of these studies are shown in Table 8-1.

When compared to raw water measurements, particle counts, TSS, NTU, gross α, and Pu were significantly reduced in the treated water samples. This treatment method had no statistically significant effect on TDS and gross β activity levels. It was also apparent that the cartridge filtration method was more consistent and more efficient than the previous Pond C-2 bag filtration method.

During the period of 1990-1992, 500 gpm capacity water treatment systems located at Ponds A-4, B-5 and C-2 (and still in place at A-4 and C-2) utilized staged 10μm and 0.5μm nominally-rated polyester bags followed by granular activated carbon (GAC) adsorptive media to treat suspected dissolved organic contamination. The bags functioned as algae prefilters to minimize the backwashing frequency of the GAC. The overall system removal efficiencies were 40-60% for TSS, and were ineffective for removal of radionuclides (EG&G, 1991).

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Table 8-1. Analytical Results - Water Treatment Cartridge Filter Pilot Test at Pond C-2

Water Sample Type	Total Particle Counts 1-150μm	TSS (mg/L)	TDS (mg/L)	Turbidity (NTU)	Gross α (pCi/L)	Gross β (pCi/L)	Pu (pCi/L)
Raw	771767	47	374	17.4	3.9	4.7	0.044
Filtered	22795	<5	360	0.97	<2	4.0	0.009
Removal Efficiency	97%	>89%	4%	94%	>49%	15%	80%

Notes:

- Raw and filtered values are the arithmetic means of three different samples
- Removal efficiency = 100 * (1- (filtered value/raw value))
- Total Particle Counts measured with Hiac\Royco® 9064 counter and HRLD-150 sensor
- Turbidity measured in field with Hach® 2100P meter
- Pu239,240 measured at Los Alamos National Lab with an isotopic mass spectrometer (Minimum Detection Limit ≅ 0.003 pCi/L)

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9. POND OPERATIONS MONITORING

Site pond operations rely on extensive surface water monitoring. Inflows to the ponds are gauged and sampled to determine the quantity and quality of water influent to the ponds. Detained terminal pond (Ponds A-4, B-5, and C-2) water is sampled and analyzed to determine suitability for discharge. Terminal pond discharge is monitored to ensure its quality and measure the quantity of water discharged. The water may be sampled and analyzed to determine its quality one more time as it flows across the Site's eastern boundary. Therefore, surface-water quality is evaluated multiple times as it travels across the Site.

The current Site water-monitoring program, which responds to CWA, CERCLA, and AIP requirements, is being modified to respond to the requirements of the newly signed RFCA. Under RFCA, the Site developed the IMP for all environmental media using a DQO process that incorporated Site, EPA, State, and Cities' input and agreement on all monitoring objectives and protocol.

9.1 STREAM GAGING STATIONS

RFCA Segment 5 monitoring will include continuous, flow-paced sampling of pond inflows using continuously operating automatic samplers located at gaging stations SW093, GS10, and SW027 (Figure 2-3) as specified by the IMP. The samples will collect a 15L composite sample that ideally representing every 500,000 gallons of water measured at the gages. The sample data will be used to compute 30-day moving averages for constituents of greatest concern (e.g. plutonium) and the averages will be compared to Site Action Levels, which are the stream standards for each segment. Exceedance of Action Levels will trigger responses for contaminant source identification and control.

The IMP specifies continuing data collection at stations SW093, GS10, and SW027 for refinement of existing pond-water management tools (e.g., correlations between stream flow and pond inflow water quality) as well as the potential for development of new management tools (e.g., correlation between turbidity and radionuclide activities). Development of new management tools might lead to more reliable and cost-effective methods for controlling pond discharge, such as automated control of pond water discharges based solely on turbidity. These gaging stations will also be equipped with real-time water quality probes which measure temperature, conductivity, pH, nitrate, and turbidity.

Stations SW093, GS11, GS08, SW027, SW022, and GS12 are each equipped with a radio telemetry system node that remotely transmits data to a computer currently located in T893A (Figure 2-3). Radio telemetry nodes are scheduled for installation at GS10, SW091, GS01, GS03, and GS31 (Figure 2-3). Gaging stations GS01 and GS03 are located at the Site east fenceline on Woman Creek and Walnut Creek, respectively. A potential fail-safe device for controlled detention operations would be a radio system node connected to an audio or visual alarm installed at the Liquid Waste Operations Control

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Room to alert Site personnel that flow or water-quality values have been exceeded and discharge modifications are warranted.

The IMP integrates pond operations with the current IA IM/IRA surface-water monitoring program. The IA monitoring will continue to collect water-quality information at several IA gaging stations to monitor for potential chronic releases of materials resulting from Site transition activities (e.g., D&D, material stabilization, waste management). The IMP refers to this monitoring as "New Source Detection Monitoring." In addition, the IMP specifies "Performance Monitoring" for contaminant control performance at Site transition project areas.

The New Source Detection and Performance Monitoring gaging stations are relocatable installations equipped with continuously recording flow meters linked to automatic water samplers which are programmed to begin sampling stream water when the flow meter detects a predetermined increase in stream stage. The samplers and flow meters are programmed to collect a 15-Liter water sample that represents the composite of 15 1-Liter samples collected from the first flush of storm runoff events. The collection of the 1-Liter samples is flow weighted to allow comparison of storm runoff sample data between different stream gages. The analytical protocol in Table 9-1 will be used for the New Source Detection and Performance Monitoring programs. Figure 2-3 shows locations of the IA IM/IRA and NPDES stormwater monitoring stations that currently provide data for contaminant source control and pond operations.

9.2 DETENTION POND LEVEL MONITORING

Operation of the detention pond network requires pond levels to be monitored so that dam safety concerns are incorporated into all pond operations decisions. The pool level elevations of Ponds A-3, A-4, and B-5 are all currently measured by Druck® pressure transducers connected to the SSW Geomation® radio telemetry system. This instrumentation gives SSW personnel the ability to assess, from a central computer located in T893A, the volume of water held in each of the ponds. In addition, the telemetry system is programmed to trigger alarms if pre-established water surface elevations for ponds are exceeded.

9.3 POND WATER DISCHARGE MONITORING

RFCA Segment 4 monitoring will include flow-paced sampling of pond discharges using continuously operating automatic gaging stations at GS11, GS08, and GS31, located below Ponds A-4, B-5, and C-2 respectively (Figure 2-3). Monitoring of Walnut Creek and Woman Creek water prior to leaving the Site boundary will be accomplished at gaging stations GS03 and GS01, respectively. These gaging stations will be known as the RFCA points of compliance. The samplers at these stations will collect composite samples over the course of each pond discharge event to represent the total volume discharged. The samples will be analyzed for constituents of greatest concern, and 30-day moving average concentration values will be computed and reported . These values will be compared to stream segment standards, and exceedance of the standards could give cause for the Site to receive Notices of Violation. These gaging stations will also be equipped with real-time water quality probes which measure temperature, conductivity, pH, nitrate, and turbidity.

The batch-and-release operations currently require sampling and analysis on a frequency which matches the frequency of discharge events. However, future pond operations will be monitored with greater reliance on continuous monitoring of both flow and water-quality parameters such as pH, nitrate, turbidity, and other parameters. Reliable continuous flow measurement will be essential at all gaging stations because flow measurement will be used to control RFCA sampling; pond inflow routing; and pond discharge rates.

Pond discharge monitoring is done in compliance with the current NPDES permit, which regulates water quality in Ponds A-3, A-4, B-5, and C-2 discharges. The Site anticipates receipt of a new NPDES permit in early 1997. Meanwhile, the Site will continue to operate under the current permit. The current permit requires routine monitoring of selected pond discharges per the requirements shown in Table 9-1. Flow meters and automatic samplers are already in place at each detention pond outlet, and continuous water-quality parameter measurement equipment is scheduled for deployment to these outfalls.

9.4 CONTROLLED DETENTION MODEL VALIDATION MONITORING

The stormwater and detention pond monitoring proposed herein will be evaluated to validate the controlled detention model. The model is based on the correlation of stream discharge, total suspended solids concentration, detention pond level, and radionuclide activities in the inflow and outflow waters. The monitoring program outlined herein will provide data for all of these parameters. Comparison of the monitoring data with model output will result in model refinement for continuous improvement of pond operations efficiency.

RFCA monitoring and analytical protocol is detailed in the IMP as determined by the DQO process. Therefore, RFCA monitoring specifications are not included in Table 9-1, and the reader is referred to the IMP.

Table 9-1. NPDES Pond Operations Monitoring and Analytical Protocol

[BMP = Best Management Practice; TSS = Total Suspended Solids; Pu, U, Am = Plutonium, Uranium Isotopes, and Americium]

Pond B-5 / GS08 - *assumes direct daily discharge*

Requirement / Regulatory Driver	Analyte (Method)	Frequency	Turn Around Time
NPDES	NVSS	daily	2 weeks
NPDES	Total Chromium	monthly	35 days
NPDES	WET	quarterly	35 days
NPDES / RFCA	pH	continuous	Real Time

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Table 9-1. NPDES Pond Operations Monitoring and Analytical Protocol (continued)

Pond A-4 / GS11 - *assumes direct daily discharge (365 days per year)*			
Requirement / Regulatory Driver	Analyte	Frequency	Turn Around Time
NPDES	NVSS	daily	2 weeks
NPDES	Total Chromium	monthly	35 days
NPDES	WET	quarterly	35 days
NPDES / RFCA	pH	continuous	Real Time

Pond C-2 / GS31 - *assumes direct daily discharge (About 20 days per year)*			
Requirement / Regulatory Driver	Analyte (Method)	Frequency	Turn Around Time
NPDES	NVSS	daily	2 weeks
NPDES	Total Chromium	monthly	35 days
NPDES	WET	quarterly	35 days
NPDES / RFCA	pH	continuous	Real Time

Pond A-3 / GS12 - *assumes direct daily discharge (365 days per year)*			
Requirement / Regulatory Driver	Analyte	Frequency	Turn Around Time
NPDES	Nitrate & Nitrite as N	daily	2 weeks
NPDES	Nitrate & Nitrite as N	daily	35 days
NPDES	pH	daily	Instantaneous
NPDES	Flow	continuous	Real Time

GS09			
Requirement / Regulatory Driver	Analyte	Frequency	Turn Around Time
BMP	Flow	continuous	Real Time

9.5 QUALITY ASSURANCE PROTOCOL

The Site has existing standard operating procedures which dictate how field work such as data collection and documentation are accomplished. A list of applicable Site data-collection procedures is shown below. In addition, standard USEPA or SW846 chemical analysis methods will be used to analyze water samples for constituents of concern (Table 9-1).

9.5.1 Applicable Standard Operating Procedures

Manual 5-21000-OPS-SW—

1. SW.02 - Field Parameter Measurement
2. SW.03 - Surface Water Sampling
3. SW.04 - Discharge Measurement
4. SW.05 - Base Laboratory Work
5. SW.10 - Event-Related Surface-Water Sampling
6. SW.11 - Operation and Maintenance of Stream-Gaging and Sampling Stations

Manual 5-21000-OPS-FO—

1. FO.03 - General Equipment Decontamination
2. FO.06 - Handling of Personal Protective Equipment
3. FO.07 - Handling of Decontamination Water and Wash Water
4. FO.11 - Field Communications
5. FO.13 - Containerization, Preserving, Handling, and Shipping of Soil and Water Samples
6. FO.14 - Field Data Management
7. FO.19 - Base Laboratory Work

Ten percent of all samples collected and analyzed will be duplicate samples and equipment rinseate samples. The duplicate sample data are used to evaluate combined sampling and analysis precision, and the rinseate sample data are used to evaluate the potential for cross-contamination between samples.

The automatic samplers have dedicated plastic carboys for containerizing the 15-Liter composite samples. These carboys are rinsed with deionized water after sample preparation is complete, and are then replaced in the samplers for the next storm runoff event. The samplers automatically flush and rinse the intake tubing each time prior to collecting a sample. However, each sample is in contact with the sampler's intake and pump tubing. Therefore, the rinseate samples are important for evaluating cross contamination and overall sampling integrity.

The quality control sample data will be evaluated annually to qualify the monitoring data and provide a measure of the overall performance of the monitoring program. The duplicate sample data will be compared to data for their real sample partners. The relative percent difference between the real sample data and the duplicate sample data will be calculated, and a relative percent difference less than 10 percent will be regarded as satisfactory. The rinseate sample data will be evaluated empirically to determine which, if any, constituents consistently are measured in unexpectedly high quantities in the rinseate waters.

9.6 RESPONSIBLE ORGANIZATIONS

Site personnel currently employed by RMRS designed, built, and operate the monitoring network (currently consisting of 23 gaging stations). This operation includes both field work and data compilation, analysis, and reporting. The monitoring task is, and needs to continue to be, closely integrated with Site environmental restoration activities, CWA compliance activities, and Site Transition activities. Therefore, alignment of responsibility for monitoring program operations with the same organizations responsible for CWA compliance and environmental restoration is appropriate.

NPDES and CWQCC standard attainment monitoring will continue to be the responsibility of RMRS, the Site contractor responsible for CWA compliance. RMRS currently subcontracts for sampling, sample tracking, and sample shipping tasks. Future (starting October 1997) configuration for sampling responsibilities is undetermined.

9.7 REPORTING

Reporting of monitoring results will occur in several documents. Currently, RMRS is the organization responsible for preparation of these documents. Table 9-2 lists the applicable reporting documents and frequency of their publication. In addition to reporting the data in comprehensive data reports and other published forms, the Site is committed to sharing all data with stakeholders as soon as it becomes available as stated in the IMP.

Table 9-2. Surface-Water Monitoring Reporting Documents

Monitoring Data Reporting Document	Publication Frequency
NPDES Discharge Monitoring Report	Monthly
Site Environmental Monitoring Report	Annually
RFCA Monitoring Reports	To Be Determined
State Data Exchange Report and Meeting	Quarterly

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Appendix A:
Rocky Flats Plant Pond Operations Plan for 1984

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Pond Operations Form
Surface Water Division

Location: ____________ Date: ____________

Activity: (Circle) Discharge Transfer Spray Evaporation Time: ____________

Activity Description: ____________

Activity Justification: ____________

Sampling Information: ____________

Sample Parameters: ____________

Date Samples Collected: ____________

Date Results Received: ____________

Estimated Start Date/Time: ____________

Estimated Completion Date/Time: ____________

Pond Level (feet,%): ____________

Release Rate (cfs, gpm): ____________

SWD Contact: ____________ Extension: ____________

DOE/RFFO Comments: ____________

Concurrence Obtained from CDPHE: (yes/no) ____________

Notification of Cities Completed: (Broomfield/Westminster) ____________

DOE/RFFO Authorization: ____________ Date: ____________

Please Return Signed Form to the SWD Contact at FAX 8482

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DRAFT

ROCKY FLATS PLANT POND OPERATIONS PLAN FOR 1994

Submitted to:
Department of Energy
Rocky Flats Office

Submitted by:
Surface Water Division
EG&G Rocky Flats, Inc.
February 23, 1994

Reviewed for Classification
By:__________________
Date:_________________

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LIST OF TABLES

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LANDFILL POND OPERATIONS PLAN

The Landfill Pond receives direct precipitation and runoff from approximately 18 acres and occasional leachate flows from the landfill until such time as OU 7 remedial actions are conducted, and this pond is either removed or replaced. During 1993, the landfill has been graded and portions in proximity to the pond have been re-vegetated. The rainfall factor for a 10 year, 6 hour storm event would approximate 2.5 inches of precipitation and contribute approximately 0.33 million gallons to the pond. The Operations Plan for the Landfill Pond is given in Table 1.

TABLE 1
LANDFILL POND OPERATIONS PLAN

	Elevation	Volume	% Full	Ops Mode
Maximum (spillway) Capacity	5921.0 feet	7.52 Mgal	100%	Emergency
Action Level 2	5920.5 feet	7.08 Mgal	95%	Emergency
Action Level 1	5916.8 feet	4.36 Mgal	60%	Normal
Preferred Operational Range	5917.0 feet	4.47 Mgal	60%	Normal
	5912.5 feet	2.26 Mgal	30%	Normal
Minimum Pool	5906.9 feet	0.74 Mgal	10%	Normal

Primary Pond Management Sequence: Landfill ⇒ A-1 ⇒ A-2 ⇒ A-3 ⇒ A-4 ⇒ Walnut Creek (Discharge)
Secondary Pond Management Sequence: Landfill ⇒ Spray Evaporation
Tertiary Pond Management Sequence: Landfill ⇒ A-1 ⇒ A-2 ⇒ Spray Evaporation

Normal Operations

The preferred operation at the Landfill pond is to transfer water that meets standards by the defined Primary Pond Management Sequence to Pond A-3 for further analysis and eventual discharge. Alternatively, small volumes may be controlled by the Secondary Pond Management Sequence, spray evaporation from the south end of the pond only. Transfers will always take precedent above 60 percent capacity, or during weather conditions that are not conducive to spray evaporation.

A minimum pool level of 5906.9 feet (10 percent) will be maintained such that sediments do not dry out and become a potential source of airborne dust emissions. Additionally pump intake lines will be situated so as to minimize the disturbance of pond sediments.

Spray evaporation activities will be terminated when weather conditions are not conducive to operations, rainstorms greater than 45 minutes in duration, thunderstorms where field personnel believe there is a lightning hazard, and during periods of high winds when warning are given throughout plantsite. This includes humidity greater than 80 percent, sustained wind speed greater than 30 miles per hour, and temperatures less than 35 degrees Fahrenheit.

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1. The water elevation is within 0.5 feet of the spillway elevation (Action Level 2), and further precipitation or inflow is predicted.

   OR

2. The water elevation is at spillway elevation (uncontrolled overflow is imminent).

   OR

3. Any one or more of the following Dam Safety/Stability conditions exist, regardless of pond elevation:

   - Turbid seepage on embankment or at toe of dam.
   - Transverse cracking on embankment crest or dam abutments.
   - Appearance of escarpments or slumping on the embankment crest or dam slopes.
   - Leakage or seepage at the dam outlet works.
   - Abrupt piezometer response.

POND A-1 OPERATIONS PLAN

Pond A-1 will potentially receive water from non-routine diversions of North Walnut Creek and from the routine transfers of the Landfill Pond. Pond A-1 will be maintained and used as the primary emergency spill control pond for the North Walnut Creek drainage until such time as OU 6 remediation efforts warrant its removal or replacement. The rainfall factor for a 25 year, 6 hour storm event would equal approximately 3.0 inches of precipitation and contribute approximately 0.33 million gallons to the pond. The Operations Plan for Pond A-1 is given in Table 2.

TABLE 2
POND A-1 OPERATIONS PLAN

	Elevation	Volume	% Full	Ops Mode
Maximum (spillway) Capacity	5929.1 feet	1.40 Mgal	100%	Emergency
Action Level 2	5828.6 feet	1.23 Mgal	88%	Emergency
Action Level 1	5828.1 feet	1.06 Mgal	76%	Normal
Normal Operational Range	5827.3 feet	0.84 Mgal	60%	Normal
	5825.9 feet	0.42 Mgal	30%	Normal
Minimum Elevation	5824.5 feet	0.14 Mgal	10%	Normal

Primary Pond Management Sequence: A-1 ⇒ A-2 ⇒ A-3 ⇒ A-4 ⇒ Walnut Creek (Discharge)
Secondary Pond Management Sequence: A-1 ⇒ A-2 ⇒ Spray Evaporation

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- EG&G will transmit (fax) a Pond Operations Form to DOE-RFO to request and obtain approval to initiate operations. DOE-RFO will transmit the signed Pond Operations Form granting or denying approval to EG&G prior to the initiation of activities, see attached Pond Operations Form.

- DOE-RFO will notify CDH and/or EPA of RFP pond operations.

Emergency Operations:

Pond A-1 will be transferred to Pond A-2, if water quality analysis is incomplete or exceeding Segment 5 standards, under the following conditions:

1. The water elevation is within 0.5 feet of the spillway elevation (Action Level 2), and further precipitation or inflow is predicted.

   OR

2. The water elevation is at spillway elevation (uncontrolled overflow is imminent).

   OR

3. Any one or more of the following Dam Safety/Stability conditions exist, regardless of pond elevation:

   - Turbid seepage on embankment or at toe of dam.
   - Transverse cracking on embankment crest or dam abutments.
   - Appearance of escarpments or slumping on the embankment crest or dam slopes.
   - Leakage or seepage at the dam outlet works.
   - Abrupt piezometer response.

POND A-2 OPERATIONS PLAN

Pond A-2 will potentially receive water from non-routine diversions of North Walnut Creek, routine transfers of Pond A-1 and Pond B-2. Pond A-2 will be maintained as a secondary emergency spill control pond for the North Walnut Creek drainage until such time as OU 6 remediation efforts warrant its removal or replacement. The rainfall factor for a 25 year, 6 hour storm event would equal approximately 3.0 inches of precipitation and contribute approximately 0.33 million gallons to the pond. The Operations Plan for Pond A-2 is given in Table 3.

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- Pond A-2 shall be sampled at SWA2 for HSL metals, volatile organics, semi-volatile organics, gross alpha and gross beta, pH, and nitrates. HSL metals will be analyzed using Inductively Coupled Plasma Emission Spectroscopy (ICPES) for all metals except arsenic, cadmium, lead, selenium, silver, and thallium that use Graphite Furnace Atomic Absorption Spectroscopy (GFAAS), and mercury with Cold Vapor Atomic Absorption Spectroscopy (CVAAS). Volatile organics will be analyzed using Standard Method 524.2 and semi-volatile organics will be analyzed using Standard Method 625.

- If the pond water exceeds Segment 5 stream standards for the parameters analyzed but is less than two standard deviations from the Segment 5 stream standard, the pond water may be spray evaporated at the pond. If the pond water meets Segment 5 stream standards, the water may be spray evaporated or transferred between the interior ponds. If the water meets Segment 4 stream standards, the water may be transferred to a terminal pond. Normal operation is to convey water pursuant to the Primary Pond Management Sequence.

Notification of Pond A-2 operations will include the following guidelines:

- EG&G will provide DOE-RFO with Status of RFP Detention Ponds approximately three days per week for the terminal ponds (A-4, A-3,B-5, & C-2) and once per week for the interior ponds (Landfill, A-1, A-2, B-1, & B-2).

- EG&G will provide DOE-RFO with Status of RFP Piezometer Readings and Dam Inspections approximately once per week.

- EG&G will provide DOE-RFO with copies of water quality analytical data prior to conducting normal operations.

- EG&G will transmit (fax) a Pond Operations Form to DOE-RFO to request and obtain approval to initiate operations. DOE-RFO will transmit the signed Pond Operations Form granting or denying approval to EG&G prior to the initiation of activities, see attached Pond Operations Form.

- DOE-RFO will notify CDH and/or EPA of RFP pond operations.

<u>Emergency Operations:</u>

Pond A-2 will be transferred to Pond A-3, if water quality analysis is incomplete or exceeding Segment 5 standards, under the following conditions:

1. The water elevation is within 0.5 feet of the drop structure elevation (Action Level 2), and further precipitation or inflow is predicted.

   OR

2. The water elevation is at the drop structure elevation (uncontrolled overflow is imminent).

   OR

Pre-discharge sampling will normally be initiated at any time the pond exceeds 30 percent of capacity. Analysis for Pond A-3 water quality will include the following guidelines:

- Pond A-3 shall be sampled prior to transfer. Pre-discharge sampling will not be conducted until transfers from Pond A-2 have ceased.
- All samples will be collected per RFP procedure EMD Operating Procedure Volume I: Field Operations, Manual Number 5-21000 OPS-FO and EMD Operating Procedure Volume IV: Surface Water, Manual Number 5-21000 OPS-SW.
- Pond A-3 shall be sampled at SWA3 for gross alpha, gross beta, tritium, pH, TDS, and nitrates.
- If the water meets Segment 4 stream standards and RFP NPDES permit limitations, the water may be transferred to Pond A-4. Normal operation is to convey water pursuant to the Primary Pond Management Sequence.

Notification of Pond A-3 operations will include the following guidelines:

- EG&G will provide DOE-RFO with Status of RFP Detention Ponds approximately three days per week for the terminal ponds (A-4, A-3,B-5, & C-2) and once per week for the interior ponds (Landfill, A-1, A-2, B-1, & B-2).
- EG&G will provide DOE-RFO with Status of RFP Piezometer Readings and Dam Inspections approximately once per week.
- EG&G will provide DOE-RFO with copies of water quality analytical data prior to conducting normal operations.
- EG&G will transmit (fax) a Pond Operations Form to DOE-RFO to request and obtain approval to initiate operations. DOE-RFO will transmit the signed Pond Operations Form granting or denying approval to EG&G prior to the initiation of activities, see attached Pond Operations Form.
- DOE-RFO will notify CDH and/or EPA of RFP pond operations.

Emergency Operations

Pond A-3 will be discharged to Pond A-4, if water quality analysis is incomplete or exceeding Segment 4 standards, under the following conditions:

1. The water elevation is within 0.5 feet of the spillway elevation (Action Level 2), and further precipitation or inflow is predicted.

   OR

2. The water elevation is at the spillway elevation (uncontrolled overflow is imminent).

   OR

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TABLE 5
POND A-4 OPERATIONS PLAN

	Elevation	Volume	% Full	Ops Mode
Maximum (spillway) Capacity	5757.9 feet	32.5 Mgal	100%	Emergency
Action Level 2	5756.9 feet	29.73 Mgal	92%	Emergency
or				
Crest Piezometer (DH-A1) Safety Elevation	5737.0 feet			Emergency
Toe Piezometer (DH-A3) Safety Elevation	5718.0 feet			Emergency
Action Level 1	5751.8 feet	17.77 Mgal	55%	Normal
Preferred Operational Range	5751.8 feet	17.77 Mgal	55%	Normal
	5741.0 feet	3.24 Mgal	10%	Normal
Minimum Pool	5741.0 feet	3.24 Mgal	10%	Normal

Primary Pond Management Sequence: A-4 ⇒ Walnut Creek (Discharge)
Secondary Pond Management Sequence: A-4 ⇒ Treatment System ⇒ Walnut Creek (Discharge)

Normal Operations

The preferred operations plan for Pond A-4 is to discharge Pond A-4 directly into Walnut Creek without treatment.

Pond A-4 will maintain a minimum pool elevation of approximately 5741.0 feet (10 percent), so that sediments do not dry out and become a potential source of airborne dust emissions.

Pre-discharge sampling will normally be initiated at any time the pond exceeds 30 percent of capacity. Pre-discharge sampling will not be conducted until transfers from Ponds A-3, B-5, and C-2 have ceased. Analysis for Pond A-4 water quality will include the following guidelines:

- Pond A-4 shall be sampled prior to discharge. Samples shall be depth composited and shall be split with the Colorado Department of Health.

- All samples will be collected per RFP procedure EMD Operating Procedure Volume I: Field Operations, Manual Number 5-21000 OPS-FO and EMD Operating Procedure Volume IV: Surface Water, Manual Number 5-21000 OPS-SW.

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OR

4. Any one or more of the following Dam Safety/Stability conditions exist, regardless of pond elevation:

- Turbid seepage on embankment or at toe of dam.
- Transverse cracking on embankment crest or dam abutments.
- Appearance of escarpments or slumping on the embankment crest or dam slopes.
- Leakage or seepage at the dam outlet works.
- Abrupt piezometer response.

The above emergency operations are subject to modification by the SOP for Water Detention Pond Dam Failure (1-15200-EPIP-12.14) which is part of the RFP Emergency Preparedness Implementation Plan. In case of discrepancies between the above described operations, and the SOP, the SOP will take precedent.

POND B-1 OPERATIONS PLAN

Pond B-1 will potentially receive water from non-routine diversions of South Walnut Creek. In addition Pond B-1 will receive stormwater diversions from the Central Avenue ditch and piped diversions of questionable STP effluent. Pond B-1 will be maintained and used as the primary emergency spill control pond for the South Walnut Creek drainage until such time as OU 6 remediation efforts warrant its removal or replacement. The rainfall factor for a 25 year, 6 hour storm event would equal approximately 3.0 inches of precipitation and contribute approximately 0.33 million gallons to the pond. The Operations Plan for Pond B-1 is given in Table 6.

TABLE 6
POND B-1 OPERATIONS PLAN

	Elevation	Volume	% Full	Ops Mode
Maximum (spillway)Capacity	5882.0 feet	1.14 Mgal	100%	Emergency
Action Level 2	5881.5 feet	1.00 Mgal	88%	Emergency
Action Level 1	5880.7 feet	0.80 Mgal	70%	Normal
Preferred Operational Range	5880.3 feet	0.69 Mgal	60%	Normal
	5878.6 feet	0.34 Mgal	30%	Normal
Minimum Pool	5877.0 feet	0.11 Mgal	10%	Normal

Primary Pond Management Sequence: B-1 ⇒ B-2 ⇒ B-3 ⇒ B-4 ⇒ B-5 ⇒ Walnut Creek (Discharge)
Secondary Pond Management Sequence: B-1 ⇒ B-2 ⇒ A-2 ⇒ Spray Evaporation
Tertiary Pond Management Sequence: B-1 ⇒ B-2 ⇒ A-2 ⇒ A-3 ⇒ A-4 ⇒ Walnut Creek (Discharge)

- EG&G will transmit (fax) a Pond Operations Form to DOE-RFO to request and obtain approval to initiate operations. DOE-RFO will transmit the signed Pond Operations Form granting or denying approval to EG&G prior to the initiation of activities, see attached Pond Operations Form.

- DOE-RFO will notify CDH and/or EPA of RFP pond operations.

Emergency Operations:

Pond B-1 will be transferred to Pond B-2, if water quality analysis is incomplete or exceeding Segment 5 standards, under the following conditions:

1. The water elevation is within 0.5 feet of the spillway elevation (action Level 2), and further precipitation or inflow is predicted.

   OR

2. The water elevation is at spillway elevation (uncontrolled overflow is imminent).

   OR

3. Any one or more of the following Dam Safety/Stability conditions exist. regardless of pond elevation:

   - Turbid seepage on embankment or at toe of dam.
   - Transverse cracking on embankment crest or dam abutments.
   - Appearance of escarpments or slumping on the embankment crest or dam slopes.
   - Leakage or seepage at the dam outlet works.
   - Abrupt piezometer response.

POND B-2 OPERATIONS PLAN

Pond B-2 will potentially receive water from non-routine diversions of South Walnut Creek and piped diversions of questionable STP effluent and routine transfers of Pond B-1. Pond B-2 will be maintained as a secondary emergency spill control pond for the South Walnut Creek drainage until such time as OU 6 remediation efforts warrant its removal or replacement. The rainfall factor for a 25 year event would equal approximately 3.0 inches of precipitation and contribute approximately 0.33 million gallons to the pond. The Operations Plan for Pond B-2 is given in Table 7.

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- Pond B-2 shall be sampled at SWB2 for HSL metals, volatile organics, semi-volatile organics, gross alpha and gross beta, pH, and nitrates. HSL metals will be analyzed using Inductively Coupled Plasma Emission Spectroscopy (ICPES) for all metals except arsenic, cadmium, lead, selenium, silver, and thallium which use Graphite Furnace Atomic Absorption Spectroscopy (GFAAS), and mercury with Cold Vapor Atomic Absorption Spectroscopy (CVAAS). Volatile organics will be analyzed using Standard Method 524.2 and semi-volatile organics will be analyzed using Standard Method 625.

- If the pond water exceeds Segment 5 stream standards for the parameters analyzed but is less than two standard deviations from the Segment 5 stream standard, the pond water may be spray evaporated at the pond. If the pond water meets Segment 5 stream standards, the water may be spray evaporated or transferred between the interior ponds. If the water meets Segment 4 stream standards, the water may be transferred to a terminal pond. Normal operation is to convey water pursuant to the Primary Pond Management Sequence.

Notification of Pond B-2 operations will include the following guidelines:

- EG&G will provide DOE-RFO with Status of RFP Detention Ponds approximately three days per week for the terminal ponds (A-4, A-3,B-5, & C-2) and once per week for the interior ponds (Landfill, A-1, A-2. B-1, & B-2).

- EG&G will provide DOE-RFO with Status of RFP Piezometer Readings and Dam Inspections approximately once per week.

- EG&G will provide DOE-RFO with copies of water quality analytical data prior to conducting normal operations.

- EG&G will transmit (fax) a Pond Operations Form to DOE-RFO to request and obtain approval to initiate operations. DOE-RFO will transmit the signed Pond Operations Form granting or denying approval to EG&G prior to the initiation of activities, see attached Pond Operations Form.

- DOE-RFO will notify CDH and/or EPA of RFP pond operations.

<u>Emergency Operations:</u>

Pond B-2 will be transferred to Pond A-2, if water quality analysis is incomplete or exceeding Segment 5 standards, under the following conditions:

1. The water elevation is within 0.5 feet of the drop structure elevation (Action Level 2), and further precipitation or inflow is predicted.

   OR

2. The water elevation is at drop structure elevation (uncontrolled overflow is imminent).

   OR

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TABLE 8
POND B-5 OPERATIONS PLAN

	Elevation	Volume	% Full	Ops Mode
Maximum (spillway) Capacity	5804.0 feet	24.65 Mgal	100%	Emergency
Action Level 2	5803.0 feet	22.92 Mgal	93%	Emergency
OR				
Crest Piezometer (WH-2) Safety Elevation	5785.0 feet			Emergency
Toe Piezometer (WH-4) Safety Elevation	5757.0 feet			Emergency
Action Level 1	5800.4 feet	17.74 Mgal	72%	Normal
Preferred Operational Range	5798.4 feet	13.55 Mgal	55%	Normal
	5784.9 feet	2.43 Mgal	10%	Normal
Minimum Elevation	5784.9 feet	2.43 Mgal	10%	Normal

Primary Pond Management Sequence: B-5 ⇒ South Walnut Creek (Discharge)
Secondary Pond Management Sequence: B-5 ⇒ A-4 ⇒ Treatment ⇒ North Walnut Creek (Discharge)

Normal Operations

The preferred operations plan for Pond B-5 is to discharge Pond B-5 directly into Walnut Creek without treatment.

Pond B-5 will maintain a minimum pool elevation of approximately 5784.9 feet (10 percent), so that sediments do not dry out and become a potential source of airborne dust emissions.

Discharge activities will be terminated after a 2 year, 6 hour storm event. The pond shall be re-sampled for the listed analytes if the volume of increases by 7.17 million gallons or more. Otherwise, the transfer shall be reinitiated 24 hours after the end of the storm event.

Pre-discharge sampling will normally be initiated at any time the pond exceeds 30 percent of capacity. Pre-discharge sampling will not be conducted until transfers from Pond C-2 have ceased. Analysis for Pond B-5 water quality will include the following guidelines:

- Pond B-5 shall be sampled prior to discharge. Samples shall be depth composited and shall be split with the Colorado Department of Health.
- All samples will be collected per RFP procedure EMD Operating Procedure Volume I: Field Operations, Manual Number 5-21000 OPS-FO and EMD Operating Procedure Volume IV: Surface Water, Manual Number 5-21000 OPS-SW.

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3. Piezometer levels WH-2 & WH-4 are equal to or greater than the recommended Safety Elevation, and further storms are predicted.

OR

4. Any one or more of the following Dam Safety/Stability conditions exist, regardless of pond elevation:

- Turbid seepage on embankment or at toe of dam.
- Transverse cracking on embankment crest or dam abutments.
- Appearance of escarpments or slumping on the embankment crest or dam slopes.
- Leakage or seepage at the dam outlet works.
- Abrupt piezometer response.

The above emergency operations are subject to modification by the SOP for Water Detention Pond Dam Failure (1-15200-EPIP-12.14) which is part of the RFP Emergency Preparedness Implementation Plan. In case of discrepancies between the above described operations, and the SOP, the SOP will take precedent.

POND C-1 OPERATIONS PLAN

Normal Operation

No active management of Pond C-1 will occur.

POND C-2 OPERATIONS PLAN

Pond C-2 will be maintained as the primary stormwater detention pond for runoff originating from the southern portion of the developed plant site. Pond C-2 will receive stormwater runoff, and treated effluent from OU 1 facilities, through the South Interceptor Ditch. The rainfall factor for a 25 year, 6 hour storm event would equal approximately 1.6 inches of precipitation and contribute approximately 5.86 million gallons to the pond. The Operations Plan for Pond C-2 is given in Table 9.

Appendix B:
Emergency Response Plan for Failure of Dams A-4, B-5 or C-2

B

Appendix B Note:

Appendix B, The Emergency Response Plan for Failure of Dams A-4, B-5, or C-2, was formally modified on July 26, 1996. This Appendix is an "Information Only" copy of the new procedure that reflects the changes made. The Document Modification Request (DMR) forms are included at the end of this Appendix.

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Rocky Flats
Environmental Technology Site

1-A25-5500-06.08

REVISION 0

EMERGENCY RESPONSE PLAN FOR FAILURE OF DAMS A-4, B-5 OR C-2

APPROVED BY:

D W Ferrera / D. W. Ferrera / 6/28/95
Director, Support Services, EG&G Rocky Flats, Inc. — Print Name — Date

Responsible Organization: Emergency Preparedness   Effective Date: June 30, 1995

CONCURRENCE BY THE FOLLOWING DISCIPLINES IS DOCUMENTED IN THE PROCEDURE HISTORY FILE:

Engineering and Safety Services
Environmental Restoration
Performance Assurance
Support Services
Waste Management
Waste Stabilization

USE CATEGORY 2

SORC review 95-011 (02/28/95)

The following has been incorporated in this revision:
94-DMR-000490

Reviewed for Classification/UCNI
By KJR UNU
Date 6/28/95

This procedure supersedes procedure 1-15200-EPIP-12.14, Revision 0.

Periodic review frequency: 1 year from the effective date.

CONTROLLED DOCUMENT
(If numbered in red ink)
No. 6

PADC-95-02061

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LIST OF EFFECTIVE PAGES

Pages	Effective Date	Pages	Effective Date
1	06/30/95		
2-4	09/13/96		
5-6	06/30/95		
7-10	09/13/96		
11	06/30/95		
12-16	09/13/96		
17	06/30/95		
18-19	09/13/96		
20-24	06/30/95		
25	09/13/96		
26	06/30/95		
27-32	09/13/96		
33	06/30/95		
34-35	09/13/96		
36-37	06/30/95		
38-39	09/13/96		
40-43	06/30/95		
44-49	09/13/96		
50-53	06/30/95		

The following DMRs are active for this procedure:

96-DMR-000664

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1. PURPOSE

This procedure describes emergency response actions required in the event of an actual or potential unplanned release, or emergency discharge of water from terminal detention ponds at Rocky Flats Environmental Technology Site (known as the Site). It defines action levels for categorizing conditions up to and including dam failure.

This procedure implements requirements of DOE Order 5500.3A, PLANNING AND PREPAREDNESS FOR OPERATIONAL EMERGENCIES, and is in consonance with the Federal Energy Regulatory Commission (FERC). The procedure also conforms to guidance outlined by the Colorado State Engineer's Office, Division of Water Resources.

2. SCOPE

This procedure applies to all Site contractor, subcontractor and DOE/RFFO employees who are tasked or become involved in emergency response actions affecting the three terminal detention ponds (A-4 and B-5 on Walnut Creek and C-2 in the Woman Creek Drainage). (See Appendix 5, Map of Detention Ponds at the Site.)

This procedure addresses action levels and responses used in mitigating actual or potential dam failures and releases (including emergency discharges) from terminal detention ponds. The following list identifies possible emergency situations:

- Overflow of a detention dam spillway
- Normal seepage through dam that exceeds established safety levels
- Abnormal seepage or abnormal piezometer response
- Partial dam failure
- Catastrophic failure of a dam
- Other conditions which may indicate an emergency situation

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2. SCOPE (continued)

For potential dam failures and releases from interior detention ponds and the Landfill Dam, the Dam Response Team will determine an appropriate action level response from routine dam inspections.

This revision is a total rewrite and revision bars are omitted. This document supersedes 1-152000-EPIP-12.14, Water Detention Pond Dam Failure, and is designated Revision 0 because the procedure number and title have been changed.

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3. OVERVIEW

The Site water detention pond system includes a series of basins and dams which retain surface water runoff and control flooding. In addition, they confine spills and detain Waste Water Treatment Plant effluent for sampling and assessment.

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The system is comprised of eleven ponds divided into three separate groups or series. Each pond (and its dam) is designated by a letter (A, B, C) indicating its series or group, and is then followed by a number, further identifying the specific pond in the group (e.g. C-2). All ponds, except the last in the series, are classified as interior ponds. The last pond, designated as the terminal detention pond, becomes the final control point for regulating surface water runoff within a series.

Seven different action levels inform and warn Site personnel of circumstances affecting the integrity of terminal ponds and dams. Action Levels 0 through 2 are also referred to as "low"; and levels 3 through 6 are termed as "high".

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Action Level 0 identifies the day-to-day monitoring activities of Surface Water (SW) and Engineering in overseeing detention ponds. Action Levels 1 and 2 permit low level monitoring and observation with increased awareness of the potential development of adverse conditions.

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3. OVERVIEW (continued)

Action Levels 3 and 4 provide a guided response to potentially adverse conditions affecting the ponds. Specifically, these levels identify preparatory actions for members of the Dam Response Team, the Shift Superintendent (SS) and support agencies. The Dam Response Team provides technical expertise during incipient stages and later in support of the Incident Command Organization (ICO) in the event of an Operational EMERGENCY.

Levels 5 and 6 are implemented when impending conditions jeopardize the integrity of the dams and the potential for an unplanned release or structural dam failure is present or has occurred. Either instance may require the SS to declare an Operational EMERGENCY in accordance with 1-15200-EPIP-04.01, Emergency Classification and implement the Site Emergency Plan, EPLAN-94 or subsequent revisions.

The following scenarios are examples of conditions which could result in an Operational EMERGENCY (ALERT or higher):

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(1) An unplanned release could occur when a pond is full to the spillway level, in which case any additional inflow to the pond will cause outflow through the spillway. Or, a major storm event may fill the pond and the volume in excess of the pond capacity will flow through the spillway. In addition, flows in earth cut spillways may cause erosion of the spillway channel and dam embankment and lead to dam failure if extensive enough. Of additional concern would be flows that exceed the spillway capacity and overtop the dam crest. These flows would likely cause extensive damage to the dam embankment.

(2) Slides, sloughs and/or cracks may appear in the dam indicating a structural deficiency. The affected area may worsen by extending, widening, deepening and moving. A portion of the dam embankment may slide, or deformation of the dam embankment may occur, to the extent that the dam fails and is no longer able to hold back water. In addition, the outlet works and valves may be blocked by soil material from the failed dam embankment.

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3. OVERVIEW (continued)

(3) Seepage within the dam embankment may rise above established safety levels for slope stability and pore pressures, as indicated by piezometer levels, leading to dam failure. In addition, seepage may appear or worsen exiting the dam slope, abutment or foundation. Saturated areas can move in massive slides and lead to failure of the dam. Seepage through the dam embankment, abutments or foundation may become excessive, of high velocity, or indicate removal of soil from the structure (piping), all of which are considered serious conditions indicative of imminent dam failure.

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(4) The outlet pipe may develop holes due to rusting, cavitation, settlement and the like. For pressurized conduits such as those at B-5 and C-2, seepage water will flow out into the dam embankment along the outlet conduit and as the hole enlarges and seepage increases, a piping failure (movement of soil from the dam embankment) starts and progresses downstream, likely leading to dam failure.

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Water release from a dam failure is likely to be a high volume in a short time period. This flow, or high velocity and volume spillway flows are likely to cause erosion and scouring of the downstream creek bed. Water from A-4 and B-5 will flow into Walnut Creek and into the Broomfield Diversion Ditch [if flow rate is less than 40 cubic feet per second (cfs)]. The Broomfield Diversion Ditch is designed to handle flows up to 40 cfs before overtopping the diversion and entering Great Western Resrvoir. However, lagging maintenance by the City of Broomfield has reduced the actual capacity to only 27 cfs at certain restriction points. Water discharged from C-2 flows into the Mower diversion ditch and into Mower Reservoir. Any flows in excess of baseflow (approximately 1 cfs) are diverted by the Woman Creek diversion box (as presently configured by Westminster) into Woman Creek Reservoir. Additionally, large releases of water from the dams may erode and weaken the foundation of Indiana Street.

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4. DEFINITIONS, ABBREVIATIONS AND ACRONYMS

4.1 List of Definitions

Other terms used in this procedure are defined in the Site EPLAN and Rocky Flats Plant Dictionary.

Action Levels. A seven-level system used to categorize current pond and dam conditions, including volume capacity, dam stability and necessary response actions at each level. These action levels range from 0 (normal conditions) to 6 (dam failure). Levels 0 through 2 are termed "low" and establish routine monitoring and periodic inspections; whereas, levels 3 through 6 are "high" and identify corrective or mitigative actions as the dam deteriorates. (See Appendix 1, Flow Chart to Determine Action Levels for Dam Failure at Terminal Ponds).

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Dam Response Team. A team comprised of members from Surface Water (SW) and Engineering who respond to normal and emergency conditions affecting detention dams. The SW representative serves as the Team Lead and the team is considered operational with two members. Managers from Sitewide Actions, Liquid Waste Disposal, and Transportation serve in advisory and support roles at high action levels (3-6).

Detention Dam. An earthen impoundment structure used at the Site for spill and flood control to detain surface water runoff and/or treated Waste Water Treatment Plant effluent, for short periods of time, to allow for water sampling and assessment of water quality prior to discharge.

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Emergency Discharge (Action Level 4). A release of pond water initiated by the Dam Response Team. This type of discharge is required when the best engineering determination indicates deteriorating conditions that could lead to dam failure. The urgency of this release would necessitate using the dam outlet structure or high volume pumping equipment.

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4.1 List of Definitions (continued)

Interior Detention Pond. Any one of a series of initial ponds used to detain or control surface water runoff or Waste Water Treatment Plant effluent. These ponds are identified as A1-A3, B1-B4 and C-1.

Operational EMERGENCY. An Operational EMERGENCY, in the context of this procedure, is any situation that would result or potentially result in the uncontrolled release or emergency discharge of pond water beyond the detention dams. An Operational EMERGENCY may be classified as an ALERT, SITE AREA EMERGENCY, or GENERAL EMERGENCY. Declaring one of these emergencies automatically activates the Emergency Response Organization (ERO). (See 1-15200-EPIP-04.01, Emergency Classification.)

Piezometer. A pipe-like device used to measure the water surface elevation within the dam and/or the pore water pressure in both dam embankments and foundations. These conditions are determined by measuring the height of the water level inside the piezometer. The water surface elevation within the dam changes with the pond pool elevation and a certain time lag is indicated by the water level in the piezometer. The water level in the piezometer responds almost immediately to changes in pore pressure.

Safety Factor. Numerical ratings for level of safety for dams under certain conditions are as follows: 1.0 is the threshold for failure; less than 1.0, failure is likely; greater than 1.0, failure potential decreases with an increase in the safety factor. The minimum design rating of dam structures is 1.5 for steady state seepage conditions.

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4.1 List of Definitions (continued)

Structural Instabilities. The physical criteria by which a dam's condition is judged to be unstable. Specifically, cracks, sloughs or seeps are all indicators of potential problems with the dam structure. Longitudinal or transverse cracks (cracks parallel or perpendicular to the dam) that are deep may be serious signs of structural problems and settling of dam layers (as opposed to surface "desiccation" cracks, which tend to be shallow and wander in any direction). Sloughing of the downstream or upstream face of a dam is a sign of potentially serious damage when the sloughing is sudden, deep, or persistent. The appearance of new seeps or the increased flow or turbidity of an existing seep is cause for concern.

Terminal Detention Pond. The last pond in a drainage series (see Appendix 5, Map of Detention Ponds at the Site) provides the final point for regulating surface water runoff. These ponds are identified as A-4, B-5 and C-2.

Unplanned Release (Action Level 5 or 6). The discharge of pond water through the dam spillway or from partial or complete dam failure, resulting from structural instabilities or excessive pond water accumulation. An unplanned release through the spillway is normally predictable from the extrapolation of current pond conditions and net inflow rates and predicted storm events, and allows ample time for notification of impacted parties and the planning for emergency discharge. An unplanned release from dam failure may be predictable with adequate notification time based on visible cracking, sloughing or seepage. However, this may not always be the case, especially with seepage failures. Treatment of pond water and determination of water quality based on analytical results may not be possible for either case prior to discharge.

Usual Piezometer Behavior Any excess change in rate of changing measurements based on the calibrations for each piezometer. For example, if a piezometer reading over a 24 hour period indicates a change in height of of the phreatic zone within the dam (i.e., a piezometer rise of more than 1/2 foot in 24 hours) suggests the dam is oversaturated and prone to failure.

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4.2 List of Abbreviations and Acronyms

Abbreviations and acronyms used in this procedure are as follows:

CDPH&E	-	Colorado Department of Public Health and Environment
cfs	-	Cubic Feet per Second
DMR	-	Document Modification Request
DOE	-	Department of Energy
DOT	-	Department of Transportation
DPS	-	Colorado Department of Public Safety
EMO	-	Emergency Management Organization
EO		Emergency Operations
EOC	-	Emergency Operations Center
EOCNO	-	Emergency Operations Center Notification Officer
EOM	-	Environmental Operations Management
EP	-	Emergency Preparedness
EPA	-	Environmental Protection Agency
EPLAN	-	Emergency Plan
ERO	-	Emergency Response Organization
ERPD	-	DELETED
EWM	-	DELETED
FEMA	-	Federal Emergency Management Agency
FERC	-	Federal Energy Regulatory Commission
HQ	-	Headquarters
IC	-	Incident Commander
ICO	-	Incident Command Organization
LWP	-	Liquid Waste Processing
NPDES	-	National Pollutant Discharge Elimination Systems
OEM	-	Environmental Operations Management
ORC	-	Operations Review Committee
RFFO	-	Rocky Flats Field Office
SA	-	Sitewide Actions
SS	-	Shift Superintendent
SW	-	Surface Water
UCNI	-	Unclassified Controlled Nuclear Information
WC&T	-	Waste Collection and Transfer

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5. RESPONSIBILITIES

5.1 Dam Response Team

Monitors the status of detention ponds to identify abnormal conditions affecting the dam (to include incipient stages of dam failure).

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Processes essential materials and, if needed, coordinates storage with Transportation or operations subcontractor(s) to ensure access in an emergency response.

Performs emergency monitoring, notification and response to assist the SS [Incident Commander (IC)] in accomplishing reporting, on-scene assessment, emergency response actions and issuance of personnel protective measures.

Provides personnel to operate the equipment and/or open valves, as required.

Ensures resources are coordinated with the SS as part of the Dam Response Team.

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Monitors and samples detention pond water on a routine basis.

Performs routine pool elevation monitoring.

Contacts labor for pond transfers and discharges.

Provides pumps and associated materials as required for pond transfers and/or discharges.

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5.2 DOE/RFFO

Notifies specific offsite agencies, as necessary, to provide information and request assistance for an unplanned release or dam failure of a detention pond (see Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2).

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5.3 Emergency Operations Center Notification Officer (EOCNO)

Notifies affected onsite and offsite agencies, as directed, to support the SS and may assist in the notification of members of the Dam Response Team (see Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.)

5.4 Employee(s)

Notifies the SS promptly if a potentially dangerous condition at one of the dam sites is observed.

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5.5 DELETED

5.6 Manager, Engineering

Assigns Engineering personnel as members of the Dam Response Team to provide structural assessment of dam(s) and evaluate conditions leading to a potential failure.

Performs notifications after duty hours to other managers/team members to activate the Dam Response Team, if requested by the SS.

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DELETED

5.7 Manager, Sitewide Actions

Serves as an advisor to the Dam Response Team during high action levels.

Provides input/oversight on environmental operations affecting the buffer zone.

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5.8 Manager, Liquid Waste Disposal

Provides Liquid Waste Disposal personnel to support the Dam Response Team.

Ensures transfer operators are available to operate transfer and treatment equipment.

5.9 Team Leader, Surface Water (SW)

Assigns SW personnel as members of the Dam Response Team who will also serve as the Team Lead.

Performs notifications after duty hours to other managers/team members to activate the Dam Response Team, if requested by the SS.

Monitors weather reports and forecasts, weather alerts and warnings, and prepares and disseminates local forecasts.

Assigns SW personnel to perform routine dam inspections, piezometer monitoring, pond pool level and volume measurements, and to make inflow/outflow determinations.

Provides safety guidance for personnel collecting samples or working on or below the dam.

Forwards a copy of dam inspection activities to Engineering and/or DOE, as appropriate.

Identifies and funds materials/minimum stock levels needed for repair of dams.

Maintains this procedure and maintains procedures for maintenance and operation of the dams.

Assigns SW personnel as members of the Dam Response Team.

Performs notifications after duty hours to other managers/team members to activate the Dam Response Team, if requested by the SS.

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5.10 Manager, Transportation

Provides Transportation personnel to support the Dam Response Team.

Provides emergency support personnel and equipment to prevent or mitigate the effects of dam failure.

Maintains stock of road base, sand, gravel sandbags for emergency use.

5.11 Program Manager, Emergency Preparedness (EP)

Ensures notifications to offsite agencies are performed in accordance with notification requirements in 4-A66-5500-04.02, Emergency Operations Center (EOC) Notification Process (except those notified by DOE/RFFO Site Support Division, Ecology Management Coordinator).

Ensures training is provided to the SS and the Dam Response Team on 1-A25-5500-06.08, Emergency Response Plan for Failure of Dams A-4, B-5 or C-2.

Coordinates with DOE/RFFO on the performance of a detention pond dam failure drill or exercise as part of the 5-year exercise program. (DOE/RFFO shall coordinate any exercise requirements with the State of Colorado and local municipalities.)

5.12 Shift Superintendent (SS)

Determines the classification of an event using 1-38300-ADM-16.02, Occurrence Categorization and 1-15200-EPIP-04.01, Emergency Classification.

Determines the necessary response effort and recalls the ERO if an Operational EMERGENCY is declared.

Assumes role of Incident Commander (IC) during an Operational EMERGENCY.

Coordinates on-scene emergency response activities, and maintains communications with the Emergency Operations Center (EOC).

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5.12 Shift Superintendent (SS) (continued)

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Activates the Dam Response Team for on-scene assessment and evaluation.

Notifies either the Environmental Restoration or Engineering and Safety representative as listed in the Emergency Management Organization (EMO) roster to activate the Dam Response Team during an "after hours" EMERGENCY affecting a detention pond dam.

Performs notifications to other onsite agencies for emergency response to detention ponds, as appropriate.

Ensures information for public and employee dissemination is gathered and forwarded to the EOC.

6. LIMITATIONS AND PRECAUTIONS

During an emergency involving detention ponds, access to dams may only be obtained from SS or Dam Response Team prior to entry, and only if absolutely necessary to evaluate the condition of the dams.

7. TRAINING

Responsible Program Managers/Managers described in this procedure must ensure all personnel are appropriately trained and qualified to perform the duties and responsibilities of assigned tasks.

8. MATERIALS AND EQUIPMENT

SW provides pumps and associated materials as required for pond transfers and/or discharges, if available, from existing stock.

SW
~~EWM~~ identifies and funds materials/minimum stock levels needed for repair of dams and arranges storage.

Transportation Department provides/transports equipment and stocked materials to prevent or mitigate the effects of dam failure. Resources will be coordinated by the SS in conjunction with the Dam Response Team and ERPD/EOM.

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9. INSTRUCTIONS—ACTION LEVEL 0

9.1 Dam Response Team

[1] Maintain Action Level 0 and continue normal operations,
IF ALL the following conditions are met:

[A] The affected pond is below 50% of capacity
(A-4 < 5751.0 ft, B-5 < 5796.5 ft, C-2 < 5760.3 ft).

[B] NO major precipitation events are predicted.

[C] The following levels apply at the affected dam:

Dam	Crest Piezometer		Toe Piezometer	
• A-4	DH-A1	< 5737 ft	DH-A3	< 5722 ft
	A4-94-02	< 5727 ft	A4-94-11	< 5724 ft
	A4-94-03	< 5729 ft	A4-94-12	< 5721 ft
• B-5	WH-1	< 5785 ft	WH-4	< 5758 ft
	WH-2	< 5783 ft	B5-94-11	< 5758 ft
	WH-3	< 5791 ft		
	B5-94-05	< 5788 ft		
	B5-94-06	< 5791 ft		
• C-2	DH-C1	< 5754 ft	DH-C2	< 5736 ft
	C2-94-02	< 5755 ft	C2-94-11	< 5744 ft
	C2-94-03	< 5742 ft	C2-94-12A	< 5741 ft
			C2-94-13A	< 5735 ft

[D] In the professional judgment of available Dam Response Team members, normal detention pond operations and inspections are appropriate.

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10. INSTRUCTIONS—ACTION LEVEL 1

10.1 Dam Response Team

NOTE *In the judgment of the Dam Response Team, Action Level 1 may be declared, as necessary, to facilitate a higher level of awareness than is provided by Action Level 0.*

[1] Declare Action Level 1,
IF ALL the conditions of either [A] or [B] are met:

[A] The affected pond has a pool elevation at or above 50% of capacity (A-4 $\geq$ 5751.0 ft, B-5 $\geq$ 5796.5 ft, C-2 $\geq$ 5760.3 ft),

AND NO major precipitation events are predicted,

AND the following levels apply at the affected dam:

Dam	Crest Piezometer		Toe Piezometer	
• A-4	DH-A1	< 5737 ft	DH-A3	< 5722 ft
	A4-94-02	< 5727 ft	A4-94-11	< 5724 ft
	A4-94-03	< 5729 ft	A4-94-12	< 5721 ft
• B-5	WH-1	< 5785 ft	WH-4	< 5758 ft
	WH-2	< 5783 ft	B5-94-11	< 5758 ft
	WH-3	< 5791 ft		
	B5-94-05	< 5788 ft		
	B5-94-06	< 5791 ft		
• C-2	DH-C1	< 5754 ft	DH-C2	< 5736 ft
	C2-94-02	< 5755 ft	C2-94-11	< 5744 ft
	C2-94-03	< 5742 ft	C2-94-12A	< 5741 ft
			C2-94-13A	< 5735 ft

- OR -

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10.1 Dam Response Team (continued)

[B] The affected pond is below 50% of capacity
(A-4 < 5751.0 ft, B-5 < 5796.5 ft, C-2 < 5760.3 ft),

AND NO major precipitation events are predicted,

AND ANY ONE of the following piezometer levels apply at the affected dam:

Dam	Crest Piezometer		Toe Piezometer	
• A-4	DH-A1	≥ 5737 ft	DH-A3	≥ 5722 ft
	A4-94-02	≥ 5727 ft	A4-94-11	≥ 5724 ft
	A4-94-03	≥ 5729 ft	A4-94-12	≥ 5721 ft
• B-5	WH-1	≥ 5785 ft	WH-4	≥ 5758 ft
	WH-2	≥ 5783 ft	B5-94-11	≥ 5758 ft
	WH-3	≥ 5791 ft		
	B5-94-05	≥ 5788 ft		
	B5-94-06	≥ 5791 ft		
• C-2	DH-C1	≥ 5754 ft	DH-C2	≥ 5736 ft
	C2-94-02	≥ 5755 ft	C2-94-11	≥ 5744 ft
	C2-94-03	≥ 5742 ft	C2-94-12A	≥ 5741 ft
			C2-94-13A	≥ 5735 ft

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11. INSTRUCTIONS—ACTION LEVEL 2

11.1 Dam Response Team

[1] Declare Action Level 2,
IF ALL the conditions of either [A], [B], [C], [D] or [E] are met:

[A] The affected pond has a pool elevation at or above 50% of capacity (A-4 $\geq$ 5751.0 ft, B-5 $\geq$ 5796.5 ft, C-2 $\geq$ 5760.3 ft),

AND ANY ONE of the following piezometer levels apply at the affected dam:

	Dam	Crest Piezometer		Toe Piezometer	
•	A-4	DH-A1	$\geq$ 5737 ft	DH-A3	$\geq$ 5722 ft
		A4-94-02	$\geq$ 5727 ft	A4-94-11	$\geq$ 5724 ft
		A4-94-03	$\geq$ 5729 ft	A4-94-12	$\geq$ 5721 ft
•	B-5	WH-1	$\geq$ 5785 ft	WH-4	$\geq$ 5758 ft
		WH-2	$\geq$ 5783 ft	B5-94-11	$\geq$ 5758 ft
		WH-3	$\geq$ 5791 ft		
		B5-94-05	$\geq$ 5788 ft		
		B5-94-06	$\geq$ 5791 ft		
•	C-2	DH-C1	$\geq$ 5754 ft	DH-C2	$\geq$ 5736 ft
		C2-94-02	$\geq$ 5755 ft	C2-94-11	$\geq$ 5744 ft
		C2-94-03	$\geq$ 5742 ft	C2-94-12A	$\geq$ 5741 ft
				C2-94-13A	$\geq$ 5735 ft

- OR -

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11.1 Dam Response Team (continued)

[B] The affected pond has a pool elevation below 50% of capacity (A-4 < 5751.0 ft, B-5 < 5796.5 ft, C-2 < 5760.3 ft),

AND ANY TWO of the following piezometer levels apply at the affected dam:

Dam	Crest Piezometer		Toe Piezometer	
• A-4	DH-A1	≥ 5737 ft	DH-A3	≥ 5722 ft
	A4-94-02	≥ 5727 ft	A4-94-11	≥ 5724 ft
	A4-94-03	≥ 5729 ft	A4-94-12	≥ 5721 ft
• B-5	WH-1	≥ 5785 ft	WH-4	≥ 5758 ft
	WH-2	≥ 5783 ft	B5-94-11	≥ 5758 ft
	WH-3	≥ 5791 ft		
	B5-94-05	≥ 5788 ft		
	B5-94-06	≥ 5791 ft		
• C-2	DH-C1	≥ 5754 ft	DH-C2	≥ 5736 ft
	C2-94-02	≥ 5755 ft	C2-94-11	≥ 5744 ft
	C2-94-03	≥ 5742 ft	C2-94-12A	≥ 5741 ft
			C2-94-13A	≥ 5735 ft

- OR -

[C] A new seep is identified.

- OR -

[D] New cracks or sloughing appears at the dam.

- OR -

[E] A major precipitation event is predicted.

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11.1 Dam Response Team (continued)

[2] Notify Waste Management of change in Action Levels as necessary.

[3] Identify equipment needed for a potential transfer to another pond or for emergency discharge with or without treatment.

[4] Increase dam inspection frequency and monitoring to 3 days per week.

[5] Change Action Levels as circumstances warrant.

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11.2 Manager, Liquid Waste Disposal

[1] Provide personnel as needed for transfer and treatment of operations.

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12. INSTRUCTIONS—ACTION LEVEL 3

NOTE 1 *Since many response actions occur simultaneously, the following paragraphs are listed alphabetically by position or team (instead of sequentially) to assist the user in quickly identifying actions to be performed.*

NOTE 2 *Appendix 1, Flow Chart to Determine Action Levels for Dam Failure at Terminal Ponds may also be used to determine Action Level 3.*

12.1 Dam Response Team

[1] Declare Action Level 3,
IF ALL the conditions of either [A], [B], [C], [D] or [E] are met:

[A] The affected pond has a pool elevation within one foot of the spillway.

- OR -

[B] The affected pond has a pool elevation at or above 50% of capacity (A-4 $\geq$ 5751.0 ft, B-5 $\geq$ 5796.5 ft, C-2 $\geq$ 5760.3 ft).

AND ANY TWO of the following piezometer levels apply at the affected dam:

Dam	Crest Piezometer		Toe Piezometer	
• A-4	DH-A1	$\geq$ 5737 ft	DH-A3	$\geq$ 5722 ft
	A4-94-02	$\geq$ 5727 ft	A4-94-11	$\geq$ 5724 ft
	A4-94-03	$\geq$ 5729 ft	A4-94-12	$\geq$ 5721 ft
• B-5	WH-1	$\geq$ 5785 ft	WH-4	$\geq$ 5758 ft
	WH-2	$\geq$ 5783 ft	B5-94-11	$\geq$ 5758 ft
	WH-3	$\geq$ 5791 ft		
	B5-94-05	$\geq$ 5788 ft		
	B5-94-06	$\geq$ 5791 ft		

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12.1 Dam Response Team (continued)

	Dam	Crest Piezometer		Toe Piezometer	
•	C-2	DH-C1	≥ 5754 ft	DH-C2	≥ 5736 ft
		C2-94-02	≥ 5755 ft	C2-94-11	≥ 5744 ft
		C2-94-03	≥ 5742 ft	C2-94-12A	≥ 5741 ft
				C2-94-13A	≥ 5735 ft

- OR -

[C] An unusual piezometer response occurs, based on historical data.

- OR -

[D] There is an unusual increase in existing seepage (quantity or quality).

- OR -

[E] Existing cracks or sloughing on the dam worsens.

[2] Notify SS and prepare for assembly as required.

[3] Notify DOE/RFFO.

[4] Increase dam inspection frequency and monitoring to 24 hour intervals.

[A] Report findings of dam inspections affecting Action Levels immediately to the SS.

[5] Obtain DOE/RFFO approval and consult with Engineering and LWP staff to initiate action to transfer water and prepare for emergency discharge with or without treatment.

[A] Ensure the transfer rate does not exceed 1 foot/day drawdown.

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12.1 Dam Response Team (continued)

[6] Determine when the inspection frequency may be reduced to 3 days per week or is no longer warranted.

[7] Change Action Levels as circumstances warrant.

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12.2 Manager, Sitewide Actions

[1] Provide oversight on operations affecting the buffer zone.

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12.3 Manager, Liquid Waste Disposal

[1] Provide personnel as needed for transfer and treatment operations.

12.4 Manager, Transportation

[1] Provide emergency support personnel, equipment and material transport to prevent dam failure, as needed.

12.5 Shift Superintendent (SS)

[1] Direct the EOCNO to perform appropriate notifications in accordance with Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2, upon implementation of Action Level 3.

[2] Activate the Dam Response Team as needed in accordance with Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[3] Consult with Dam Response Team to determine Action Level changes, as necessary.

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13. INSTRUCTIONS—ACTION LEVEL 4

NOTE *Since many response actions occur simultaneously, the following paragraphs are listed alphabetically by position or team (instead of sequentially) to assist the user in quickly identifying actions to be performed. Action Levels 4 through 6 are declared when safety is about to be or already has been compromised. The first five conditions which trigger an Action Level 4 Declaration are early warning signs of dam failure. The sixth condition is somewhat subjective, in that it allows for declaration of Action Level 4 if a combination of conditions exists which most likely will lead to uncontrolled discharge via the dam spillway. The dam team should seek to use managed discharge. Pond water models are allowed criteria for determining the maximum credible event for which discharge can be managed.*

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13.1 Dam Response Team

NOTE *Action Level 4 may also be determined using the logic decision format found in Appendix 1, Flow Chart to Determine Action Levels for Dam Failure at Terminal Ponds.*

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[1] Declare Action Level 4,
IF ALL the conditions of either [A], [B], [C], [D], [E], or [F] are met:

[A] Existing seepage quantity through the dam is increasing **OR** quality is actively and progressively worsening.

- OR -

[B] Existing cracks or sloughing is actively and progressively worsening.

- OR -

[C] The pond has a pool elevation at the spillway.

- OR -

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13.1 Dam Response Team (continued)

[D] The affected pond has a pool elevation at or above 50% of capacity (A-4 $\geq$ 5751.0 ft, B-5 $\geq$ 5796.5 ft, C-2 $\geq$ 5760.3),

AND ANY of the following piezometer levels apply at the affected dam:

Pond	Crest Piezometer		Toe Piezometer	
• A-4	DH-A1	$\geq$ 5746 ft	DH-A-3	$\geq$ 5724 ft
	A4-94-02	$\geq$ 5752 ft	A4-94-11	$\geq$ 5730 ft
	A4-94-03	$\geq$ 5750 ft	A4-94-12	$\geq$ 5725 ft
• B-5	WH-1	$\geq$ 5787 ft	WH-4	$\geq$ 5760 ft
	WH-2	$\geq$ 5786 ft	B5-94-11	$\geq$ 5762 ft
	WH-3	$\geq$ 5801 ft		
	B5-94-05	$\geq$ 5800 ft		
	B5-94-06	$\geq$ 5800 ft		
• C-2	DH-C1	$\geq$ 5763 ft	DH-C2	$\geq$ 5739 ft
	C2-94-02	$\geq$ 5761 ft	C2-94-11	$\geq$ 5747 ft
	C2-94-03	$\geq$ 5760 ft	C2-94-12A	$\geq$ 5750 ft
			C2-94-13A	$\geq$ 5751 ft

- OR -

[E] A combination of ANY two criteria in Action Level 3 exists.

- OR -

[F] If the pond has pool elevation two feet below the spillway, antecedent soil moisture conditions indicate soils are saturated, a significant precipitation event with surface water runoff is ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours.

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13.1 Dam Response Team (continued)

[2] Assemble as required by the SS.

[3] Perform notifications according to Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[4] Increase dam inspection frequency and monitoring to eight hour intervals, seven days per week.

[A] Report summary results of dam inspections affecting Action Levels immediately to the SS.

[5] Implement environmental sampling as required in accordance with Appendix 3, Environmental Water and Sediment/Soil Sampling.

NOTE *If not already accomplished in Action Level 3, obtain DOE/RFFO approval to initiate action to transfer water and prepare for emergency discharge, with or without treatment.*

[6] Increase the transfer rate to approximately one foot per day of drawdown, or initiate an emergency discharge through the standpipe or pumping station at a rate of approximately one foot of drawdown per day, with or without treatment. (See Appendix 4, Maximum Drawdown Flow Rates for Ponds A-4, B-5 and C-2.)

[7] Determine when the inspection frequency may be reduced.

[8] Coordinate request for an onsite inspection by the State Engineer to determine the safety and stability of the dam and provide recommendations.

[9] Consult with SS to change Action Levels as circumstances warrant.

[10] Establish safety guidance for personnel collecting samples or working on or below the dam.

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13.2 DOE/RFFO

[1] Complete notifications to offsite agencies as identified in Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

13.3 Emergency Operations Center Notification Officer (EOCNO)

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[1] Complete notifications as directed by the SS.

13.4 Manager, Sitewide Actions

[1] Provide oversight on operations affecting the buffer zone.

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13.5 Manager, Liquid Waste Disposal

[1] Provide personnel as needed for transfer and treatment operations.

13.6 Manager, Transportation

[1] Provide emergency support personnel, equipment and material transport to prevent dam failure, as needed.

13.7 SS

[1] Direct the EOCNO to perform appropriate notifications in accordance with Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[2] Activate the Dam Response Team as needed in accordance with Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[3] Ensure data for public and employee information development and dissemination is given to the Communications Department.

[4] Consult with Dam Response Team to determine Action Level changes, as necessary.

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14. INSTRUCTIONS—ACTION LEVEL 5

NOTE *Since many response actions occur simultaneously, the following paragraphs are listed alphabetically by position or team (instead of sequentially) to assist the user in quickly identifying actions to be performed.*

14.1 Dam Response Team

NOTE *Action Level 5 may also be determined using the logic decision format found in Appendix 1, Flow Chart to Determine Action Levels for Dam Failure at Terminal Ponds.*

[1] Declare Action Level 5,
IF conditions of either [A], [B] or [C] are met:

[A] Seepage through the dam exhibits high velocity flow, excessive quantity or quality indicative of piping.

- OR -

[B} Soil movement is indicative of an active critical slope failure in the earthen embankment.

- OR -

[C] An unplanned release is occurring through a spillway.

[2] Complete emergency notifications to onsite agencies as outlined in Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[3] Establish safety guidance for personnel collecting samples or working on or below the dam.

[4] Monitor emergency conditions and perform duties as requested by the SS.

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14.1 Dam Response Team (continued)

[A] Report emergency conditions affecting Action Levels immediately to the SS.

[5] Monitor release rates as required to provide a drawdown rate of approximately 2 feet per day or more.

[6] Increase the inspection frequency to at least every 2 hours, or to the appropriate level of frequency and report results immediately to SS and other members of the Dam Response Team.

[7] Implement environmental sampling as required in accordance with Appendix 3, Environmental Water and Sediment/Soil Sampling.

[8] Complete a structural assessment of the dam(s).

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[9] DELETED

[10] Gather and evaluate engineering inspection data, meteorological data, piezometer readings and assessment information.

[11] Change Action Levels as circumstances warrant.

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14.2 DOE/RFFO

[1] Complete notifications to offsite agencies as identified in Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

14.3 EOCNO

[1] Complete notifications to offsite agencies in accordance with 4-A66-5500-04.02, Emergency Operations Center (EOC) Notification Process.

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14.4 Employee(s)

> **WARNING**
>
> **When dam failure is imminent, evacuation takes priority over notifying the Shift Superintendent (SS).**

[1] **IF** on scene and you witness a potentially dangerous condition at one of the dam sites,

[A] Evacuate the downstream area of the dam.

[B] **THEN** notify the SS immediately.

[2] **IF** in the buffer zone and notification is received of a potential or actual dangerous condition at one of the dam sites,
THEN move to higher ground and follow instructions provided.

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14.5 Manager, Sitewide Actions

[1] Provide oversight on operations affecting the buffer zone.

14.6 Manager, Liquid Waste Disposal

[1] Provide personnel as needed for transfer and treatment operations.

14.7 Manager, Transportation

[1] Provide emergency support personnel, equipment and material transport to prevent dam failure, as needed.

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14.8 SS

[1] Declare an Operational EMERGENCY according to 1-15200-EPIP-04.01, Emergency Classification.

[2] Respond as IC in accordance with 3-A14-5500-01.61, Incident Command Organization.

[A] Activate the Dam Response Team and ensure assessment/evaluation of the on-scene situation in accordance with Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[B] Coordinate on-scene emergency response activities and maintain communications with the EOC.

[C] Ensure data for public and employee information development and dissemination is given to the Communications Department.

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15. INSTRUCTIONS—ACTION LEVEL 6

NOTE *Since many response actions occur simultaneously, the following paragraphs are listed alphabetically by position or team (instead of sequentially) to assist the user in quickly identifying actions to be performed.*

15.1 Dam Response Team

NOTE *Action Level 6 may also be determined using the logic decision format found in Appendix 1, Flow Chart to Determine Action Levels for Dam Failure at Terminal Ponds.*

[1] Declare Action Level 6,
IF conditions of either [A] or [B] are met:

[A] A detention dam has failed.

- OR -

[B] A detention dam failure is imminent in the professional judgment of available Dam Response Team members,

Detention pond capacities at 100% are:

A-4 - 32.5 million gallons
B-5 - 24.6 million gallons
C-2 - 22.6 million gallons

[2] Complete emergency notifications to onsite agencies as outlined in Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[3] Monitor emergency conditions and perform duties as requested by the SS.

[A] Report emergency conditions affecting Action Levels immediately to the SS.

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15.1 Dam Response Team (continued)

[4] Establish emergency discharge rates, as feasible.

[5] Coordinate with offsite agency field monitoring response teams.

[6] Provide pumps and associated materials as required for pond transfers and/or discharges.

[7] Notify additional personnel needed to operate the equipment and/or open valves, as required.

[8] Increase inspection frequency to continuously.

[9] Establish safety guidance for personnel collecting samples or working on or below the dam.

[10] Evaluate conditions relative to failure modes.

[11] Implement environmental sampling as required in accordance with Appendix 3, Environmental Water and Sediment/Soil Sampling.

[12] Gather and evaluate engineering inspection data, meteorological data, piezometer readings and assessment information.

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15.2 DOE/RFFO

[1] Complete notifications to offsite agencies as identified in Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

15.3 EOCNO

[1] Complete notifications to offsite agencies in accordance with 4-A66-5500-04.02, Emergency Operations Center (EOC) Notification Process.

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15.4 Employee(s)

WARNING
When dam failure is imminent, evacuation takes priority over notifying the Shift Superintendent (SS).

[1] **IF** on scene and you witness a potentially dangerous condition at one of the dam sites,

[A] Evacuate the downstream area of the dam.

[B] **THEN** notify the SS immediately.

[2] **IF** in the buffer zone and notification is received of a potential or actual dangerous condition at one of the dam sites,
THEN move to higher ground and follow instructions provided.

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15.5 Manager, Sitewide Actions

[1] Provide oversight on operations affecting the buffer zone.

15.6 Manager, Liquid Waste Disposal

[1] Provide personnel as needed for transfer and treatment operations.

15.7 Manager, Transportation

[1] Provide emergency support personnel, equipment and material transport to prevent dam failure, as needed.

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15.8 SS

[1] Declare an Operational EMERGENCY according to 1-15200-EPIP-04.01, Emergency Classification.

[2] Respond as IC in accordance with 3-A14-5500-01.61, Incident Command Organization.

[A] Activate the Dam Response Team and ensure assessment/evaluation of the on-scene situation in accordance with Appendix 2, Notification Listing for Failure of Dams A-4, B-5 or C-2.

[B] Coordinate on-scene emergency response activities and maintain communications with the EOC.

[C] Ensure data for public and employee information development and dissemination is given to the Communications Department.

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16. RECORDS

No Quality Assurance Records are generated by this procedure.

16.1 All Agencies

[1] Sign, date and forward logs, records of action and other pertinent data to the Manager, Emergency Operations (EO) in care of the EOC.

16.2 Manager, Emergency Operations (EO)

[1] Review and classify logs, records of action and other data pertaining to emergency response at terminal dams A-4, B-5 and C-2.

[2] Maintain emergency response records in accordance with 1-77000-RM-001, Records Management Guidance for Records Sources.

17. REFERENCES

Colorado Radiological Emergency Response Plan, Rocky Flats

DOE 5000.3B, Occurrence Reporting and Processing of Operations Information

DOE 5500.1B, Emergency Management System

DOE 5500.2B, Emergency Categories, Classes, and Notification and Reporting Requirements

DOE 5500.3A, Planning and Preparedness for Operational Emergencies

Federal Emergency Management Agency (FEMA) Federal Guidelines for Dam Safety

Operation and Maintenance Instructions for the Rocky Flats Surface Water Control Project, 1980

Rocky Flats Discharge Elimination Systems (NPDES) Permit, CO-0001333, Effective November 26, 1984

Rocky Flats Environmental Technology Site Emergency Plan, EPLAN-94

State of Colorado Water Quality Control Commission Stream Standards for Segments 4 and 5 of Big Dry Creek, South Platte River Basin

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17. REFERENCES (continued)

1-15200-EPIP-04.01, Emergency Classification

1-38300-ADM-16.02, Occurrence Categorization

1-77000-RM-001, Records Management Guidance for Records Sources

1-A34-5500-06.09, Emergency Notification and Response for RFP Construction Sites and Buffer Zone Activities

2-G18-ER-ADM-17.01, Quality Assurance Records Management

3-A14-5500-01.61, Incident Command Organization

4-A66-5500-04.02, Emergency Operations Center (EOC) Notification Process

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APPENDIX 1

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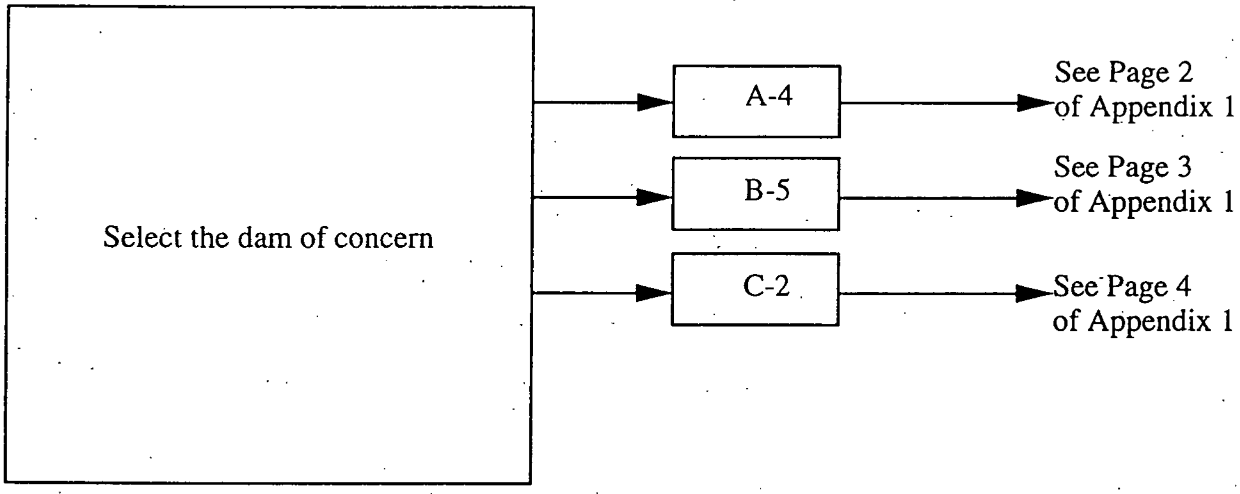
FLOW CHART TO DETERMINE ACTION LEVELS FOR DAM FAILURE AT TERMINAL PONDS



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APPENDIX 1

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POND A-4 DAM FAILURE RESPONSE

Do either of the following 2 conditions exist?

1) Dam has failed.
2) Dam failure imminent based on professional judgment of Dam Response Team members

Yes → Action Level 6

No ↓

Do any of the following 3 conditions exist?

1) Seepage through dam exhibits high velocity flow, excessive quantity indicative of piping
2) Soil movement is indicative of an active critical slope failure in the earthen embankment.
3) Unplanned release occurring through spillway.

Yes → Action Level 5

No ↓

Do any of the following 5 conditions exist?

1) Seepage rate through dam is increasing or quality is actively and progressively worsening.
2) Existing cracks or sloughing are actively and progressively worsening.
3) A-4 Pond level at 5757.9 feet (at level of spillway).
4) A-4 Pond level greater than or equal to 5751.0 feet (A-4 Pond at 50% capacity)
5) If the pond has pool elevation two feet below the spillway, a significant precipitation with surface water runoff in ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours

and

any piezometer meets the following conditions:

Crest piezometers	Toe piezometers
(DH-A1) ≥ 5746 feet	(DH-A3) ≥ 5724 feet
(A4-94-02) ≥ 5752	(A4-94-11) ≥ 5730 feet
(A4-94-03) ≥ 5750 feet	(A4-94-12) ≥ 5725 feet

Yes → Action Level 4

96-DMR-000694

No ↓

Do any two of the following 5 conditions exist?

1) A-4 pond level greater than or equal to 5756.9 feet (level within 1 foot of spillway)
2) A-4 pond level greater than or equal to 5751.0 feet (A-4 pond at 50% capacity)

and

any two piezometer meet the following conditions:

Crest piezometers	Toe piezometers
(DH-A1) ≥ 5737 feet	(DH-A3) ≥ 5722 feet
(A4-94-02) ≥ 5727 feet	(A4-94-11) ≥ 5724 feet
(A4-94-03) ≥ 5729 feet	(A4-94-12) ≥ 5721 feet

3) Unusual piezometer response (based on historical trends).
4) Unusual increase in existing seepage (quantity or quality).
5) Existing cracks or sloughing on the dam worsening.

Yes → Action Level 4

No ↓

Do any of the following 5 conditions exist?

1) A-4 pond level greater than or equal to 5756.9 feet (A-4 pond level within 1 foot of spillway level)
2) A-4 pond level greater than or equal to 5751.0 feet (A-4 pond at 50% capacity)

and

any two piezometer meet the following conditions:

Crest piezometers	Toe piezometers
(DH-A1) ≥ 5737 feet	(DH-A3) ≥ 5722 feet
(A4-94-02) ≥ 5727	(A4-94-11) ≥ 5724 feet
(A4-94-03) ≥ 5729 feet	(A4-94-12) ≥ 5721 feet

3) Unusual piezometer response (based on historical trends).
4) Unusual increase in existing seepage (quantity or quality).
5) Existing cracks or sloughing on the dam worsening.

Yes → Action Level 3

No ↓

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Action level is 2 or less. Failure of Dam [illegible]-4 is not imminent.

NOTE: Caution should be used during [illegible]ods of high rain or runoff as conditions can change quickly

APPENDIX 1
Page 3 of 4

POND B-5 DAM FAILURE RESPONSE

Do either of the following 2 conditions exist?

1) Dam has failed.
2) Dam failure imminent based on professional judgment of Dam Response Team members

Yes → Action Level 6

No ↓

Do any of the following 3 conditions exist?

1) Seepage through dam exhibits high velocity flow, excessive quantity indicative of piping
2) Soil movement is indicative of an active critical slope failure in the earthen embankment.
3) Unplanned release occurring through spillway.

Yes → Action Level 5

No ↓

Do any of the following 5 conditions exist?

1) Seepage rate through dam is increasing or quality is actively and progressively worsening.
2) Existing cracks or sloughing are actively and progressively worsening.
3) B-5 Pond level at 5804.0 feet (at level of spillway).
4) B-5 Pond level greater than or equal to 5796.5 feet (B-5 Pond at 50% capacity)
5) If the pond has pool elevation two feet below the spillway, a significant precipitation with surface water runoff in ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours

and

any piezometer meets the following conditions:

Crest piezometers	Toe piezometers
(WH-1) ≥ 5787 feet	(WH-4) ≥ 5760 feet
(WH-2) ≥ 5786 feet	(B5-94-11) ≥ 5762 feet
(WH-3) ≥ 5801 feet	
(B5-94-05) ≥ 5800 feet	
(B5-94-06) ≥ 5800 feet	

Yes → Action Level 4

96-DUR-000674

No ↓

Do any two of the following 5 conditions exist?

1) B-5 pond level greater than or equal to 5803.0 feet (level within 1 foot of spillway)
2) B-5 pond level greater than or equal to 5796.5 feet (B-5 pond at 50% capacity)

and

any two piezometer meet the following conditions:

Crest piezometers	Toe piezometers
(WH-1) ≥ 5785 feet	(WH-4) ≥ 5758 feet
(WH-2) ≥ 5783 feet	(B5-94-11) ≥ 5758 feet
(WH-3) ≥ 5791 feet	
(B5-94-05) ≥ 5788 feet	
(B5-94-06) ≥ 5791 feet	

3) Unusual piezometer response (based on historical trends).
4) Unusual increase in existing seepage (quantity or quality).
5) Existing cracks or sloughing on the dam worsening.

Yes → Action Level 4

No ↓

Do any of the following 5 conditions exist?

1) B-5 pond level greater than or equal to 5803.0 feet (level within 1 foot of spillway)
2) B-5 pond level greater than or equal to 5796.5 feet (B-5 pond at 50% capacity)

and

any two piezometer meet the following conditions:

Crest piezometers	Toe piezometers
(WH-1) ≥ 5785 feet	(WH-4) ≥ 5758 feet
(WH-2) ≥ 5783 feet	(B5-94-11) ≥ 5758 feet
(WH-3) ≥ 5791 feet	
(B5-94-05) ≥ 5788 feet	
(B5-94-06) ≥ 5791 feet	

3) Unusual piezometer response (based on historical trends).
4) Unusual increase in existing seepage (quantity or quality).
5) Existing cracks or sloughing on the dam worsening.

Yes → Action Level 3

No ↓

Action level is 2 or less. Failure of Dam B-5 is not imminent.

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POND C-2 DAM FAILURE RESPONSE

Do either of the following 2 conditions exist?

1) Dam has failed.
2) Dam failure imminent based on professional judgment of Dam Response Team members

Yes → Action Level 6

No ↓

Do any of the following 3 conditions exist?

1) Seepage through dam exhibits high velocity flow, excessive quantity indicative of piping
2) Soil movement is indicative of an active critical slope failure in the earthen embankment.
3) Unplanned release occurring through spillway.

Yes → Action Level 5

No ↓

Do any of the following 5 conditions exist?

1) Seepage rate through dam is increasing or quality is actively and progressively worsening.
2) Existing cracks or sloughing are actively and progressively worsening.
3) C-2 Pond level at 5765.3 feet (at level of spillway).
4) C-2 Pond level greater than or equal to 5760.3 feet (C-2 Pond at 50% capacity)
5) If the pond has pool elevation two feet below the spillway, a significant precipitation with surface water runoff in ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours

and

any piezometer meets the following conditions:

Crest piezometers	Toe piezometers
(DH-C-1) ≥ 5763 feet	(DH-C2) ≥ 5739 feet
(C2-94-02) ≥ 5761 feet	(C2-94-11) ≥ 5747 feet
(C2-94-03) ≥ 5760 feet	(C2-94-12A) ≥ 5750 feet
	(C2-94-13A ≥ 5751 feet

Yes → Action Level 4

No ↓

Do any two of the following 5 conditions exist?

1) C-2 pond level greater than or equal to 5764.3 feet (level within 1 foot of spillway)
2) C-2 pond level greater than or equal to 5760.3 feet (C-2 pond at 50% capacity)

and

any two piezometer meet the following conditions:

Crest piezometers	Toe piezometers
(DH-C-1) ≥ 5754 feet	(DH-C2) ≥ 5736 feet
(C2-94-02) ≥ 5755 feet	(C2-94-11) ≥ 5744 feet
(C2-94-03) ≥ 5742 feet	(C2-94-12A) ≥ 5741 feet
	(C2-94-13A ≥ 5735 feet

3) Unusual piezometer response (based on historical trends).
4) Unusual increase in existing seepage (quantity or quality).
5) Existing cracks or sloughing on the dam worsening.

Yes → Action Level 4

No ↓

Do any of the following 5 conditions exist?

1) C-2 pond level greater than or equal to 5764.3 feet (level within 1 foot of spillway)
2) C-2 pond level greater than or equal to 5760.3 feet (C-2 pond at 50% capacity)

and

any two piezometer meet the following conditions:

Crest piezometers	Toe piezometers
(DH-C1) ≥ 5754 feet	(DH-C2) ≥ 5736 feet
(C2-94-02) ≥ 5755 feet	(C2-94-11) ≥ 5744 feet
(C2-94-03) ≥ 5742 feet	(C2-94-12A) ≥ 5741 feet
	(C2-94-13A ≥ 5735 feet

3) Unusual piezometer response (based on historical trends).
4) Unusual increase in existing seepage (quantity or quality).
5) Existing cracks or sloughing on the dam worsening.

Yes → Action Level 3

No ↓

Action level is 2 or less. Failure of Dam C-2 is not imminent.

96-DAR-000661

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APPENDIX 2
Page 1 of 2

NOTIFICATION LISTING FOR FAILURE OF DAMS A-4, B-5 OR C-2

	During duty hours	After duty hours
1. DAM RESPONSE TEAM	**During duty hours**	**After duty hours**
Surface Water, Team Leader K. M. Motyl	Phone 966-2172 Pager 966-4000 (ID 1881)	Notify Shift Superintendent activates call list
Sitewide Actions, Manager J. E. Law	Phone 966-4842 Pager 966-4000 (ID 4364) Cellular 880-7055	Phone 730-6293
Engineering	Phone 966-5419	Notify Shift Superintendent activates call list
Liquid Waste Disposal, Manager	Phone 966-7729	LWO Control Room Phone 966-4653
Transportation, DynCorp	Telephone ext 4530	24 Hour Pager: 966-4000 (ID 1314) Trucking Dispatch: 966-2267; Pager 966-4000 (ID 2268)
2. ON SITE AGENCIES (Notified by SS or EOCNO)	**During duty hours**	**After duty hours**
Central Alarm Station Wackenhut Services LLC	Phone 966-2444	Same as duty hours
Communications Representative S. Nevil	Phone 966-5989	Notify Shift Superintendent activates the call list
DOE Communications P. Etchart	Phone 966-7547	Notify Shift Superintendent activates the call list
3. ON SITE AGENCIES (Notified by Dam Response Team)	**During duty hours**	**After duty hours**
RMRS Operations Division Manager A. M. Tyson	Phone 966-4829	Per Call List
K-H Sitewide Multimedia Logisitics G. H. Setlock	Phone 966-4457 Pager 966-4000 (ID 5380)	Phone 443-5673
DOE/RFFO J. Stover	Phone 966-9735 Pager 966-4000 (ID 3601)	Phone 451-1065
DOE Facility Representative D. McCranie	Phone 966-9695	Per Call List

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APPENDIX 2
Page 2 of 2

4. **OFFSITE AGENCIES**
[Notified by EOCNO, per 4-A66-5500-04.02, Emergency Operations Center (EOC) Notification Process]

DOE Headquarters (HQ)

Colorado Office of Emergency Management (OEM)

Colorado Department of Public Health and Environment (CDPH&E)

Colorado Department of Public Safety (DPS)

Jefferson and Boulder Counties

5. **OFFSITE AGENCIES**
(Notified by DOE/RFFO)

	During Duty Hours
City of Arvada	
Water Quality & Environmental Service	Phone 431-3042
City of Broomfield	
Public Works	Phone 438-6400
K. Schnoor	Phone 438-6363
City of Northglenn	Phone 451-1289
Natural Resources, Water & Sewer	
City of Thornton	Phone 538-7425
Public Works, Utilities, Sewer-Water	
City of Westminster	
City Hall, Water Breaks & Sewer Backups	Phone 430-2400
D. Kanuisto	Phone 430-2400, ext 2181

96-RMRR-000660

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96-DWR-000664

APPENDIX 3

Page 1 of 1

ENVIRONMENTAL WATER AND SEDIMENT/SOIL SAMPLING

Water samples collected during an unplanned release or emergency discharge shall be analyzed for the items listed in the following table as required for predischarge to segment 4. If the unplanned release included pond sediments or soils, analysis of these materials should be analyzed for items listed in the following table:

WATER SAMPLES	SOIL AND SEDIMENT SAMPLES
• Volatile Organics (Method 524.2) • Semi-Volatile Organics (CLP) • HSL (ICP & AA) Metals (Dissolved & Total) • Inorganic Water Quality Parameters •• Ammonia •• Chloride •• Cyanide (Free) •• Fluoride •• Nitrate/Nitrite •• Nitrite •• Sulfate •• Sulfide •• Total Dissolved Solids •• Total Suspended Solids •• Total Phosphates •• Water Hardness • Radiochemical Parameters (Total) •• Americium 241 •• Gross alpha, beta •• Plutonium 239/240 •• Tritium •• Uranium 233/234/235/238 • Biomonitoring (Whole Effluent Toxicity) •• Ceriodaphnia, 48-hour Acute •• Fathead Minnow, 96-hour Acute •• Microtox	• Semi-Volatile Organics (CLP) • HSL (ICP & AA) Metals (Dissolved & Total) • Radiochemical Parameters (total) •• Americium 241 •• Gross alpha, beta •• Plutonium 239/240 •• Tritium •• Uranium 233/234/235/238 • Acute Soil Toxicity •• Ceriodaphnia, 48-hour Acute •• Fathead Minnow, 96-hour Acute •• Herbicides (Method 8150) •• Microtox •• Triazine Herbicides (Method 619)

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Report changes to the Shift Superintendent and DOE/RFFO.

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RFPF - 1000.01 (5/95)
Formerly RF-47940

Document Modification Request

Print or Type All Information (Except Signatures). Process procedures in accordance with 1-A01-PROC DEV-400, Procedure Process

25. DMR. No.
96-DMR-000664

Originator

1. Name/Phone/Page/Location
William J. Burdelik, Ext. 5126, Digital 3133, Bldg. T893A

2. Date
Jul 23, 1996

3. Existing Document Number/Revision
1-A25-5500-06.08, Revision 0

4. Document Type [X] Procedure [ ] Plan [ ] Other

5. Document Title
Emergency Response Plan for Failure of Dams A-4, B-5 or C-2

6. Item	7. Page	8. Step	9. Proposed Modifications
1	3	TOC	Delete section 5.5: "Manager, Ecology and Watershed Management (EWM)". Organization no longer exists, all activities transferred to Surface Water organization.
2	3, 4	TOC	Change sections 5.2, 13.2, 14.2, and 15.2 from "DOE/RFFO Site Support Division, Ecology Management" to "DOE/RFFO"; sections 5.7, 12.2, 13.4, 14.5, and 15.5 to: "Manager, Sitewide Actions"; and section 5.8, 11.2, 12.3, 13.5, and 14.6, and 15.6 to: "Manager, Liquid Waste Disposal"
3	7	3.	Paragraph 1, revise first sentence: "The Site water detention pond system includes a series of basins and dams which retain surface water runoff and control flooding."
4	7	3.	Paragraph 2, revise last sentence as: "The last pond, designated as the terminal detention pond, becomes the final control point for regulating surface water runoff within a series."
5	7	3.	Paragraph 4, revise first sentence as: " Action Level 0 identifies the day-to-day monitoring activities of Surface Water (SW) and Engineering in overseeing detention ponds."

10. Item

10a. Justification (Reason for Modification, EJO#, TP#, etc.)

The "Emergency Response Plan for Failure of Dams A-4, B-5 or C-2" is out of date. Organization names have changed, some organizations have been eliminated, and recent occurrences have prompted the need for procedural change. The DOE has requested the Surface Water team leader update this procedure to ensure dam safety and water quality issues are given proper priority when responding to emergency situations.

DMR / Procedure approved for use until controlled distribution copy is received.

9/24/96
Date
Document Control Representative

Originator's Supervisor

11. [X] Process
[ ] Do not Process (state reason in block 10a)
(print/sign/date) Keith Motyl / Keith M Motyl 8-30-96

Responsible Manager

12. [X] Process (Complete Blocks 13-22)
[ ] Do not Process (state reason in block 10a)
(print/sign/date) [illegible] 9/13/96
[illegible] 8-31-96

13. New Document/ Rev. No. (if new or changed)
Revision 0

Complete either Section 14a. or 14b., as applicable

14a. Type of Complete Modification
[ ] New [ ] Revision [ ] One-Time-Use [ ] Cancellation

For procedures, attach completed Procedure Modification worksheet from 1-A01-PROC DEV-400.
14b. Changes: (check all that apply.)
[X] Intent Change
[ ] Editorial Correction
[ ] Nonintent Change
[ ] Regular
[ ] Interim Approval Requested - Needed for immediate Use (14 day limit for obtaining final approval)

Additional Attributes:
[ ] Temporary
[ ] One-Time-Use
[ ] Limited Distribution

15. ERM Change Control Board Required: Yes [ ] No [X] (Applicable only to new procedures, revisions, or intent changes.)

List the reviewing disciplines in Block 16. After concurrence has been obtained(in accordance with 1-AO1-PROC DEV-400), enter the name of the reviewer followed by / s/ in block 17. If the reviewer indicates No Comments, the review signature constitutes concurrence. Enter the date concurrence is obtained in block 18.

16. Organization	17. Reviewer/Concuror	18. Date	16a. Organization	17a. Reviewer/Concuror	18a. Date
RMRS/SSW	K.M. Motyl Keith M Motyl	8-30-96			
RMRS/SA	J.E. Law [signature]	8-30-96			
RMRS/QAPM	S. Luker [signature]	8-30-96			
K-H	G.H. Setlock George Setlock	8-30-96			
DOE	J. Stover John Stover	9/3/96			

19. Assigned SME/Phone/Page/Location
C. Hoffman, Ext. 5762, Digital 1820, Bldg. T893A

20. Cost Center
0203

21. Charge Number
971109-01

22. Requested Completion Date
Sep 13, 1996

23. Prescreen/Screen/USDQ Number
Exempt

24. Independent Safety Review Meeting and Date
SORC 96-034 9/22/96

26. After obtaining ALL required signatures: Responsible Manager's Approval (print/sign/date) (Not Required for New procedures or Revisions)
R.G. Card [signature] 9-6-96

27. Effective Date
9-13-96

28. Expiration Date (if applicable)

INFORMATION ONLY

REVIEWED FOR CLASSIFICATION/UCNI
By [signature]

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RFPF - 1000.01 (5/95)
Formerly RF-47940

DMR (continuation sheet)

Print or Type All Information (Except Signatures). Process procedures in accordance with 1-A01-FROC DEV-400, Procedure Process

DMR. No. 96-DMR-000664

Originator

3. Existing Document Number/Revision: 1-A25-5500-06.08, Revision 0

5. Document Title: Emergency Response Plan for Failure of Dams A-4,

6. Item	7. Page	8. Step	9. Proposed Modifications
6	8	3. (1)	Insert the word "cause" in first sentence: "...pond will cause outflow through..." w JB 9/13 F16
7	9	3. (3)	Replace word " elevations" with "levels" in the first sentence: "...by piezometer levels, leading to..."
8	9	3. (4)	Remove "A-4" from second sentence: "... conduits such as those at B-5 and C-2..."
9	9	3.	Replace sentences four and five with: "The Broomfield Diversion Ditch is designed to handle flows up to 40 cfs before overtopping the diversion and entering Great Western Reservoir, however, lagging maintenance by the City of Broomfield has reduced the actual capacity to only 27cfs at certain restriction points."
10	9	3.	Replace sentence six in last paragraph of section with: "Water discharged from C-2 flows into the Mower diversion ditch and into Mower Reservoir. Any flows in excess of baseflow (approx. 1 cfs) are diverted by the Woman Creek diversion box (as presently configured by Westminster) into Woman Creek Reservoir."
11	10	4.1	Update Dam Response Team definition as: "A team comprised of members from Surface Water (SW) and Engineering who respond to normal and emergency conditions affecting detention dams. The SW representative serves as the Team Lead and the team is considered operational with two members. Managers from Sitewide Actions, Liquid Waste Disposal, and Transportation serve in advisory and support roles at high levels (3-6).
12	10	4.1	Replace "imminent" in Emergency Discharge (Action Level 4) definition with: "deteriorating conditions that could lead to" dam failure.
13	~~11~~ 12 w JB 9/13/96	4.1	Add a new definition: Usual Piezometer Behavior. Any excess change in rate of changing measurements based on the calibrations for each piezometer. For example, if a piezometer reading over a 24 hour period indicates a change in height of the phreatic zone within the dam (i.e., a piezometer rise of more than 1/2 foot in 24 hours) suggests the dam is over saturated and prone to failure.
14	12	4.1	Revise last sentence as: "Treatment of pond water and determination of water quality based on analytical results may not be possible for either case prior to discharge."
15	13	4.2	Change abbreviation of ERPD to: "SA - Sitewide Actions"
16	13	4.2	Delete abbreviation EWM
17	14	5.1	Revise second sentence as: " Procures essential materials and, if needed, coordinates storage with Transportation or operations subcontractor(s) to ensure access in an emergency."
18	14	5.2	Update title to: "DOE/RFFO"
19	15	5.5	Update title to: "Team Leader, Surface Water"
20	15	5.5	Revise first sentence/paragraph as: "Assigns SW personnel as members ..."
21	15	5.5.	Revise fourth sentence/paragraph as: "Assigns SW personnel to perform routine dam inspections , piezometer monitoring, pond pool level and volume measurements, and to make inflow/outflow determinations."
22	15	5.5	Add sixth sentence paragraph: Maintains this procedure.
23	15	5.6	Transfer responsibilities to Team Leader, Surface Water "Provides safety guidance for personnel collecting. samples or working on or below the dam." and "Maintains procedures for maintenance and operation of the dams" from Manager, Engineering

10. Item	10a. Justification (Reason for Modification, EJO#, TP#, etc.)

26. After obtaining ALL required signatures: Responsible Manager's Approval (print/sign/date) (Not Required for New procedures or Revisions)

R.G. Card

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RFPF - 1000.01 (5/95)
Formerly RF-47940

DMR (continuation sheet)

Print or Type All Information (Except Signatures). Process procedures in accordance with 1-A01-FROC DEV-400, Procedure Process

DMR. No. 96-DMR-000664

Originator

3. Existing Document Number/Revision: 1-A25-5500-06.08, Revision 0

5. Document Title: Emergency Response Plan for Failure of Dams A-4,

6. Item	7. Page	8. Step	9. Proposed Modifications
24	16	5.7	Update title to: "Manager, Sitewide Actions"
25	16	5.9	Merge unique items in Team Leader, Surface Water (SW) list (last four) into section 5.1. Eliminate section 5.9
26	18	5.12	In the second sentence, change "Environmental and Waste Management" to "Environmental Restoration".
27	19	8.	In sentence 2, change "EWM" to "SW".
28	25	11.1	Change item [2] "Notify Waste Management of change in Action Levels as necessary."
29	27	12.1	Revise item[2] as follows: "Notify shift superintendent and prepare for assembly as required."
30	27	12.1	Revise item [3] as follows: "Notify DOE/RFFO".
31	28	12.2	Update title to: "Manager, Sitewide Actions"
32	28	12.3	Update title to: "Manager, Liquid Waste Disposal"
33	29	13.	Append the NOTE to include a discussion on proactive water management.: "Action Levels 4 through 6 are Declared when dam safety is about to or already has been compromised. The first five conditions which trigger an Action Level 4 Declaration are early warning signs of dam failure. The sixth condition is somewhat subjective, in that, it allows for Declaration of Action Level 4 if a combination of conditions exists which most likely will lead to uncontrolled discharge via the dam spillway. The dam team should seek to use managed discharge. Pond water models are allowed criteria for determining the maximum credible event for which discharge can be managed.
34	~~29~~ 30 WJB 9/13/96	13.1	Insert condition [F] (action level 4 proactive trigger): "If the pond has pool elevation two feet below the spillway, antecedent soil moisture conditions indicate soils are saturated, a significant precipitation event with surface water runoff is ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours.
35	31	13.1	Add task for Dam Response Team under action level 4 (delete same from action level 5): "[10] Establsih safety guidance for personnel collecting samples or working on or below the dam."
36	~~31~~ 32 WJB 9/13/96	13.2	Update title to: "DOE/RFFO"
37	32	13.4	Update title to ; "Manager, Sitewide Actions"
38	32	13.5	Update title to: "Manager, Liquid Waste Disposal"
39	34	14.1	Delete item [9], redundant with item [5], and renumber section
40	34	14.2	Update title to: "DOE/RFFO"
41	35	14.5	Update title to: "Manager, Sitewide Actions"
42	35	14.6	Update title to: "Manager, Liquid Waste Disposal"
43	38	15.2	Update title to: "DOE/RFFO"
44	39	15.5	Update title to: "Manage, Sitewide Actions"

10. Item	10a. Justification (Reason for Modification, EJO#, TP#, etc.)

26. After obtaining ALL required signatures: Responsible Manager's Approval (print/sign/date) (Not Required for New procedures or Revisions)

R.G. Card

204

RFPF - 1000.01 (5/95)
Formerly RF-47940

DMR (continuation sheet)

Print or Type All Information (Except Signatures). Process procedures in accordance with 1-A01-FROC DEV-400, Procedure Process

Originator

DMR. No.
96-DMR-000664

3. Existing Document Number/Revision
1-A25-5500-06.08, Revision 0

5. Document Title
Emergency Response Plan for Failure of Dams A-4,

6. Item	7. Page	8. Step	9. Proposed Modifications
45	39	15.6	Update title to: "Manager, Liquid Waste Disposal"
46	44	Appdx. 1, Pond A-4	Add a 5) condition to the third box: "If the pond has pool elevation two feet below the spillway, a significant precipitation with surface water runoff is ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours."
47	45	Appdx. 1, Pond B-5	Add a 5) condition to the third box: "If the pond has pool elevation two feet below the spillway, a significant precipitation with surface water runoff is ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours.
48	46	Appdx. 1, Pond C-2	Add a 5) condition to the third box: "If the pond has pool elevation two feet below the spillway,, a significant precipitation with surface water runoff is ongoing, and pond water modeling indicates influent rates will result in uncontrolled spillway discharge within 2 hours.
49	47	Appdx. 2	Replace appendix 2 with the following:

NOTIFICATION LISTING FOR EMERGENCY RESPONSE PLAN FOR FAILURE OF DAMS A-4, B-5, or C-2

1. DAM RESPONSE TEAM	During Duty Hours	After Duty Hours
Surface Water, Team Leader K.M. Motyl	Phone: 966-2172 , Pager: 966-4000 (ID 1881)	Notify the Shift Superintendent activates call list
Sitewide Actions, Manager J.E. Law	Phone: 966-4842 Pager: 966-4000 (ID 4364) Cellular Phone: 880-7055	Phone: 730-6293
Engineering	Phone 966-5419	Notify the Shift Superintendent activates call list
Liquid Waste Disposal, Manager	Phone: 966-7729	LWO Control Room Phone: 966-4653
Transportation, DynCorp	Phone: 966-4529	24 Hour Pager:966-4000 (ID 1314) Trucking Dispatch: 966-2267 Pager 966-4000 (ID 2268)

2. ON-SITE AGENCIES [Notified by the SS or EOCNO]	During Duty Hours	After Duty Hours
Central Alarm Station Wackenhut Services, Inc.	Phone: 966-2444	Same as duty hours
Communications Representative S. Nevil	Phone: 966-5989	Notify the Shift Superintendent activates call list
DOE Communications P. Etchart	Phone: 966-7547	Notify the Shift Superintendent activates call list

10. Item	10a. Justification (Reason for Modification, EJO#, TP#, etc.)

26. After obtaining ALL required signatures: Responsible Manager's Approval (print/sign/date) (Not Required for New procedures or Revisions)
R.G. Card

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RFPF - 1000.01 (5/95)
Formerly RF-47940

DMR (continuation sheet)

Print or Type All Information (Except Signatures). Process procedures in accordance with 1-A01-FROC DEV-400, Procedure Process

DMR. No. 96-DMR-000664

Originator

3. Existing Document Number/Revision: 1-A25-5500-06.08, Revision 0

5. Document Title: Emergency Response Plan for Failure of Dams A-4,

6. Item	7. Page	8. Step	9. Proposed Modifications

3. ON-SITE AGENCIES — During Duty Hours — After Duty Hours
[Notified by Dam Response Team]

Agency	During Duty Hours	After Duty Hours
RMRS Operations Division Manager A.M. Tyson	Phone: 966-4829	Per Call List
K-H Sitewide MultiMedia Logistics G.H. Setlock	Phone: 966-4457 Pager: 966-4000 (ID 5380)	Phone: 443-5673
DOE RFFO J. Stover	Phone: 966-9735 Pager: 966-4000 (ID 3601)	Phone: 451-1065
DOE Facility Representative D. McCranie	Phone: 966-9695	Per Call List

4. OFFSITE AGENCIES — During Duty Hours — After Duty Hours
[Notified by EOCNO, per 4-A66-5500-04.01, Emergency Operations Center (EOC) Notification Process]

DOE Headquarters (HQ)

Colorado Office of Emergency Management (OEM)

Colorado Department of Public Health and Environment (CDPH&E)

4. OFFSITE AGENCIES — During Duty Hours — After Duty Hours
[Notified by EOCNO, per 4-A66-5500-04.02, Emergency Operations Center (EOC) Notification Process]

Colorado Department of Public Safety (DPS)

Jefferson and Boulder Counties

5. OFFSITE AGENCIES — During Duty Hours — After Duty Hours
[Notified by DOE, RFFO]

Agency	During Duty Hours	After Duty Hours
City of Arvada Water Quality and Environmental Service	Phone: 431-3042	
City of Broomfield Public Works	Phone: 436-6400	
K. Schnoor	Phone: 438-6363	
City of Northglenn Natural Resources, Water and Sewer	Phone: 451-1289	
City of Thornton Public Works, Utilities, Sewer-Water	Phone: 538-7425	

10. Item — 10a. Justification (Reason for Modification, EJO#, TP#, etc.)

26. After obtaining ALL required signatures: Responsible Manager's Approval (print/sign/date) (Not Required for New procedures or Revisions)

R.G. Card

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RFPF - 1000.01 (5/95)
Formerly RF-47940

DMR (continuation sheet)

Print or Type All Information (Except Signatures). Process procedures in accordance with 1-A01-FROC DEV-400, Procedure Process

DMR. No. 96-DMR-000664

Originator

3. Existing Document Number/Revision	5. Document Title
1-A25-5500-06.08, Revision 0	Emergency Response Plan for Failure of Dams A-4,

6. Item	7. Page	8. Step	9. Proposed Modifications
			continue 5. <u>OFFSITE AGENCIES</u> <u>During Duty Hours</u> <u>After Duty Hours</u> (Notified by DOE, RFFO) City of Westminister Phone: 430-2400 City Hall, Water Breaks and Sewer Backups D. Kanuisto Phone: 430-2400 ext 2181
50	49	Appdx. 3	Change table description to read: "Water samples collected during an unplanned release or emergency discharge shall be analyzed for the items listed in the following table as required for predischarge to segment 4. If the unplanned release included pond sediments or soils, analysis of these materials should be analyzed for items listed in the following table." Herbicides and Triazine Hebicides should not included under the heading of Biomonitoring for Water Samples. Replace Soil and Sediment Samples Biomonitoring category with "Acute Soil Toxicity" Replace sentence following table with "Report changes to the Shift Superintendent and DOE/RFFO."

10. Item	10a. Justification (Reason for Modification, EJO#, TP#, etc.)

26. After obtaining ALL required signatures: Responsible Manager's Approval (print/sign/date) (Not Required for New procedures or Revisions)

R.G. Card

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APPENDIX 4
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MAXIMUM DRAWDOWN FLOWRATES FOR PONDS A-4, B-5 AND C-2

Pond A-4

Elevation (ft)	Volume (Mgal)	Capacity	Max (gpm)	Max (cfs)
5738.0	1.48	5%	---	---
5739.0	1.96	6%	333	0.74
5740.0	2.55	8%	410	0.91
5741.0	3.24	10%	479	1.07
5742.0	4.06	12%	569	1.27
5743.0	4.98	15%	639	1.43
5744.0	6.00	18%	708	1.58
5745.0	7.12	22%	778	1.74
5746.0	8.35	26%	854	1.91
5747.0	9.69	30%	931	2.08
5748.0	11.13	34%	1000	2.23
5749.0	12.70	39%	1090	2.43
5750.0	14.37	44%	1160	2.59
5751.0	16.20	50%	1271	2.84
5752.0	18.16	56%	1361	3.04
5753.0	20.26	62%	1458	3.26
5754.0	22.49	69%	1549	3.46
5755.0	24.85	76%	1639	3.66
5756.0	27.35	84%	1736	3.88
5757.0	29.99	92%	1833	4.09
5757.9	32.49	100%	1929	4.31

Pond B-5

Elevation (ft)	Volume (Mgal)	Capacity	Max (gpm)	Max (cfs)
5782.0	1.31	5%	---	---
5783.0	1.64	7%	229	0.51
5784.0	2.03	8%	271	0.60
5785.0	2.47	10%	306	0.68
5786.0	2.97	12%	347	0.78
5787.0	3.53	15%	389	0.87
5788.0	4.15	17%	431	0.96
5789.0	4.83	20%	472	1.05
5790.0	5.56	23%	507	1.13
5791.0	6.36	27%	556	1.24
5792.0	7.22	30%	597	1.33
5793.0	8.15	34%	646	1.44
5794.0	9.16	38%	701	1.57
5795.0	10.25	43%	757	1.69
5796.0	11.43	48%	819	1.83
5797.0	12.71	53%	889	1.98
5798.0	14.08	59%	951	2.12
5799.0	15.54	65%	1014	2.26
5800.0	17.08	71%	1069	2.39
5801.0	18.71	78%	1132	2.53
5802.0	20.44	85%	1201	2.68
5803.0	22.26	93%	1264	2.82
5803.9	23.99	100%	1335	2.98

Pond C-2

Elevation (ft)	Volume (Mgal)	Capacity	Max (gpm)	Max (cfs)
5751.0	0.91	4%	---	---
5752.0	1.39	6%	333	0.74
5753.0	2.00	9%	424	0.95
5754.0	2.77	12%	535	1.19
5755.0	3.70	16%	646	1.44
5756.0	4.81	21%	771	1.72
5757.0	6.09	27%	889	1.98
5758.0	7.50	33%	979	2.19
5759.0	9.04	40%	1069	2.39
5760.0	10.73	47%	1174	2.62
5761.0	12.59	56%	1292	2.88
5762.0	14.62	65%	1410	3.15
5763.0	16.82	74%	1528	3.41
5764.0	19.19	85%	1646	3.67
5765.0	21.81	97%	1819	4.06
5765.3	22.60	100%	1829	4.08

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APPENDIX 5

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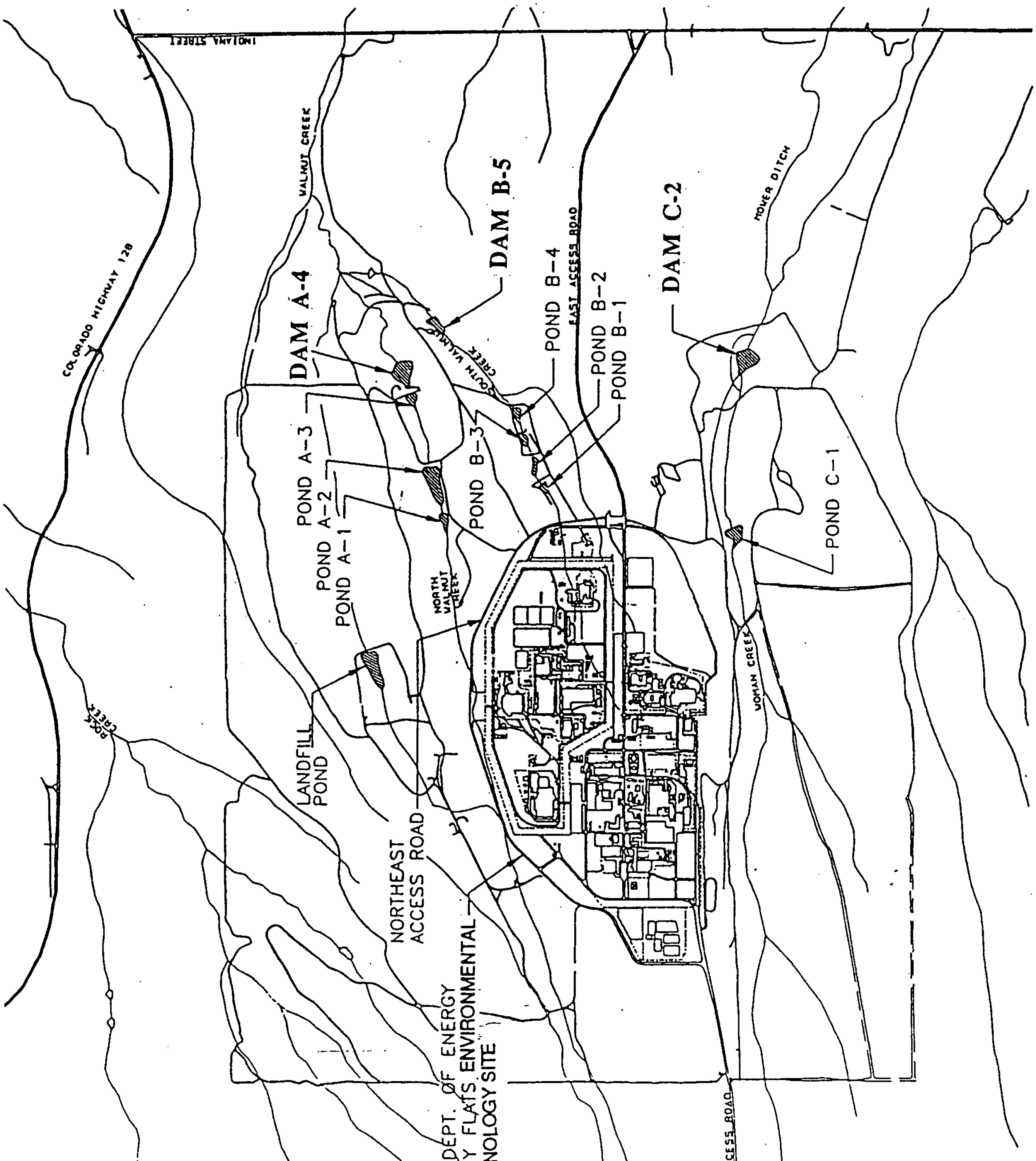
MAP OF DETENTION PONDS AT THE SITE



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Appendix C: Occurrence of Plutonium in Rocky Flats Environs

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C. OCCURRENCE OF PLUTONIUM IN ROCKY FLATS ENVIRONS

C.1 INTRODUCTION

This section discusses the nature and occurrence of radionuclides, particularly plutonium, in Site environs. The characterization and control of radionuclides in waters discharged from Rocky Flats have been discussed earlier by DOE.[1] Understanding the physicochemical and occurrence of radionuclides are key components in controlling radionuclide levels in surface water. The following section contains three major components: nature and sources of radionuclides, occurrence and disposition, and natural and anthropogenic control measures relevant to controlling plutonium levels in Site surface water.

Today the majority of surface-waterborne plutonium at the Site has as its source term contamination (soils and sediments) from past practices. Plutonium is a chemically reactive metal and any environmental deposits are substantially converted in the presence of water and oxygen to rather insoluble hydroxide or oxide forms. As a purely practical matter, these oxo forms of plutonium become associated to soils and other adsorptive solids, and generally require vigorous chemical treatment to remove them.[2]

Transport of existing Site environmental plutonium occurs primarily by resuspension and erosional effects mediated by wind and water. Under these slow erosive forces plutonium sources continue to diminish with time as natural erosional processes of wind and water have dispersed them over a period of decades. Potential new sources are another matter and may also be important in the future as cleanup and decommissioning continue; the potential form of such contaminant sources can only be speculated and appropriate controls instituted to protect against credible releases to surface water. Pond operations should protect against both present, better characterized source terms and future sources that could arise as a result of ER or D&D activities.

C.2 GENERAL OCCURRENCE PLUTONIUM IN THE ENVIRONMENT

The movement of contaminants deposited in the environment depends on transport by a flowing (i.e., fluid) media, generally either air or water and the tendency of the contaminant to partition or pick up by the moving fluid phase. This document, having a focus on surface water and Site pond operations, concentrates on plutonium mobilized and transported by water, and wind dispersal.

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[1] *Workplan for the Control of Radionuclide Levels in Water Discharges from the Rocky Flats Plant*, Department of Energy, Rocky Flats Office, 21000-WP-125 01.1, January 1992.

[2] *Work Plan for Chemically Enhanced Steam Stripping of Radionuclides from Rocky Flats (RFP) Soils*, Department of Energy, Rocky Flats Plant, SiteP/ER-94-00003, April 1994.

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Given the dynamic nature of flowing systems, it seems clear that chronic contamination arises from either new sources (including newly uncovered environmental sources and potential "leaks") and/or by the slow but continuing transport and dispersal of existing sources which maintain contaminant levels. From a surface-water quality perspective sources of plutonium can be separated into two broad categories of those available for transport and those which are not. As a result of failure of radiological control systems contamination, normally contained to protect HS&E, can enter the environment.

To evaluate availability of plutonium for transport and potential contamination of surface water some knowledge is needed of its occurrence in *existing* sources in or contributing to the environment. Additionally, the nature of potential newer sources should be considered, especially those that might arise from changes to or failures in containment systems, or from disturbances to existing sources that might modify their release rate to the watercourse. Predicting the nature and behavior of newer source terms based on new release scenarios presents the most challenge. For purposes of surface-water management, the behavior of new sources is difficult to generalize, but will be assumed to mimic existing sources in terms of affinity for and their relative slow movement through soils.

Under this assumption and following any release (of plutonium-containing solutions or particulates) and short environmental exposure, waterborne plutonium partitions into two compartments — one mobile, the other sedentary which is the major fraction. Under environmental conditions both components equilibrate to produce oxo (oxide or hydroxide) species by reaction with the abundant water or oxygen. Once the mobile fraction disperses, only the sedentary fraction remains for slower dispersal by mainly physical/erosional forces. The physicochemical properties of the eroded, now waterborne, plutonium assume the nature of the larger aggregates or particulates with which they associate — they are not plutonium-like in their behavior. The erosion of these latter, sedentary deposits comprise the majority fraction of plutonium in surface waters at the Site.

The interest of the plan is in those plutonium-contaminated phases where it is potentially available for transport through the watershed. Because the major sources of plutonium in the Site environs are largely historical releases deposited Pu to soil and sediment, a discussion of plutonium occurrence in these media is reviewed. Additionally, since the nature of waterborne Pu should complement that in the sediment, the occurrence of Pu in Site water is also discussed.[3] The discussion of relevant environmental plutonium issues is divided into several subsections: occurrence in the environment, occurrence in soils and

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[3] Additionally, since the resuspension and transport of soils and sediments occurs in a size-selective manner (i.e., smaller particles are more readily moved than larger), the nature and properties of sediment- and soil-borne plutonium can differ substantially. A mass balance for waterborne Pu should occur of the form,

$$Pu(water) = Pu(soil) - Pu(bed\ sediments) - Pu(biota)$$

where Pu in the water-mobilized soil will remain suspended or become sediment. The more refractory or larger-size components accumulating in sediments, whereas, the smaller or more soluble fractions are transported downstream.

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sediments, mobility of in soils and sediments, occurrence in water, and summary and generalization of results.

C.3 OCCURRENCE OF PU IN SOILS AND SEDIMENTS

Bondietti and Tamura[4] have reviewed the chemistry and associations of plutonium and other actinides in soils. The sorption of actinides can be strongly influenced by speciation, i.e., its physical form and chemical oxidation state, which are in turn influenced by environmental conditions, especially variations in pH and e_H of the solution. The initial adsorption on soils (often from ηCi per liter or higher solutions) is apparently complex and "attempts to correlate Pu adsorption with soil type [is complicated] by the complex interplay between soil components and the stability of various Pu oxidation-state species."

However, once adsorbed or associated with soils, at least in the case of Site soils, there is less uncertainty in Pu behavior and its tendency for strong attachment to soil particles. From a surface water-quality control perspective, the relevant information is in the relative activity of surficial-adsorbed material which is available for transport, whether by purely physical forces or physicochemical mechanisms.

Little[5] characterized Site surficial soils on the basis of activity per mass of a given particle-size fraction for various 903 Pad Area soils for depths to 21 cm. Pu activities on per gram basis were determined for soil fractions in the range of 0-2000μm for seven equivalent 3-cm horizons to 21 cm. Activity levels showed an inverse dependence on particle size that would be expected based on the assumptions that (a) Pu adsorbs uniformly on particles based solely on the availability of sites and (b) the availability of sites is proportional only to the available surface area for a given class of particles[6]. Using the well-known relationships for spherical particles,

$$\text{Surface Area} = \pi d^2 \qquad \text{and} \qquad \text{Volume} = \pi d^3/6$$

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[4] Bondietti, E.A. and Tamura, T., "Physicochemical Associations of Plutonium and Other Actinides in Soil," in *Transuranic Elements in the Environment*, W.C. Hanson, Ed., DOE/TIC 22800, 1980, pp. 145-164.

[5] Little, C.A., "Plutonium in a Grassland Ecosystem," in *Transuranic Elements in the Environment*, W.C. Hanson, Ed., DOE/TIC 22800, 1980, pp. 425-28.

[6] Although the bulk chemical properties of Site surficial soils have been characterized, knowledge of the *surface* physicochemical nature (and therefore the sorption chemistry) of environmental particulates is not generally available. Environmental particulates are comprised of complex mixtures of components making surface chemistry difficult to generalize. While particle size—a parameter which is readily determined at least — does not uniquely define its sorptive (i.e., surficial) properties, to a first approximation available activity versus size correlations support the $(\text{size})^{-1}$ trend. This activity versus particle size relationship is useful for predicting transport and settling properties, and make activity-size relationships attractive predictive tools.

the activity per unit mass is proportional to 1/d (i.e., inversely proportional to particle size) if a uniformity of available sorption sites is expected.[7] Of course as the roughness of particles increases, surface area increases and volume (and consequently, mass) decreases and one expects the 1/d dependence to be a bounding condition with actual values between 0 and -1. Little found that the slopes of log-log plots of [Pu] versus particle diameter varied non-systematically mostly between -0.3 and -0.8 for soil depths of 0-3 and 12-15 cm.

C.4 MOBILITY OF PLUTONIUM IN SOILS AND SEDIMENTS

Litaor et al.[8] have described the control of plutonium movement through soils by various pedogenic and geologic features including subsurface boundaries, porosity, and burrowing of ground-dwelling creatures. While the movement through soils is generally slow, storm events involving heavy surficial flow have been shown to transport actinides in the Site's OU2[9] area. Reflecting the current understanding and for purposes of this plan, the movement of plutonium and americium occurs primarily via transport mechanisms involving dispersal of surficial deposits via wind dispersion and overland water flows. On these occasions, surficial soils are involved, and attached radionuclides are potentially dispersed; perhaps to a depth of 2 inches (5 cm).

This thesis is based on the following general conditions at the Site: (1) Pu occurs mainly in surficial deposits which were affected and dispersed by wind and water dispersion mechanisms over some 2-3 decades, (2) Pu occurrence in Site soils varies inversely with depth with 90% occurring within the first

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[7] Here, the working assumption is that adsorption of Pu on particulate occurs primarily via its attachment to surficial sites, whose availability is determined as a percentage of total surface area. If particle diameter, surface area, and volume of particles are (under a spherical-particle approximation) related by the well-known relationships,

$$\text{Surface Area} = \pi d^2 \text{ and } \qquad \text{Volume} = \pi d^3/6 \qquad \text{then}$$

$$\text{Activity / Mass} \cong \pi d^2 / ((\pi d^3)/6) \qquad \text{or} \qquad \text{Activity/gram} \propto 6/d$$

This construct is particularly attractive in a predictive sense since surface chemistry of soil/sediment particles from a given storm event is difficult to predict, whereas, the properties controlling physical transport and settling of particles are readily modeled.

[8] Litaor, M.I. et al., "Plutonium-239+240 and Americium-241 in Soils East of Rocky Flats, Colorado," *J. Envir. Qual.*, **1994**, *23(6)*,1231.

[9] Wetherbee, G.A., personal communication, October, 1995.

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C.6 MOBILIZATION/TRANSPORT OF PLUTONIUM IN WATER

Cleveland and Rees[12] investigated the influence of complexation of plutonium by natural (humic) organic substances on its solubility. Attempted dissolution of plutonium from Site soils into aqueous solutions of fulvic acid produced little solubility gain over plain water. Only a small fraction of the Pu was soluble and very low, solubility limits were indicated. The resulting solutions were unstable, and most Pu (and Am) re-precipitated within a few days.

A second related area of interest is that of the re-suspension or solubilization of radionuclides deposited in pond and lake sediments. Rees et al.[13] evaluated re-dispersion of sediments from Site Pond B-1 (average Pu activities of 1.6 nanocuries per gram (nCi/g)) by a combination of intense physical agitation, pH adjustment, and subsequent separation by centrifugation or filtration to assess: (1) activity vs. particle size, and (2) particle re-suspension and solubilization of radionuclides. Results of this study indicated 74% of the plutonium activity occurred in the sediment fraction 4.6-9 micrometer (μm) in size, while less than 5% of the activity resided in the less than 2.3 μm fraction. They concluded that temporary re-dispersal of up to 5% of sediment activity was possible at pH 9 and above. They surmised that the re-dispersed phase probably occurred as discrete colloids, or adsorbates on sediment particles, whose average size decreased with increasing pH. The re-dispersed phase re-absorbed onto the source sediments with time. The authors suggested that downstream migration of Pu in sediments would be "slow," since its solubilization even at elevated pH was difficult.

Recent studies[14,15] have evaluated the particle sizes and chemistry of sub-pCi Pu in natural watercourses. Results indicate considerable variability in particle sizes—some as small as 0.02 micron—depending on the environmental conditions present. Results showed movement of plutonium through surficial soils and sediments which was postulated to involve colloidal transport.

Cleveland and Rees[16] (Cleveland 1982) investigated the mobility of plutonium in groundwater involving an underground wastewater injection well at the Idaho National Engineering Laboratory. The volcanic

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[12] Cleveland et al., "Investigation of the Solubilization of Plutonium and Americium in Soil by Natural Humic Compounds," *Environ. Sci. and Technol.*, **1976**, *10*, 802.

[13] T.F. Rees et al. "Dispersion of Plutonium from Contaminated Pond Sediments," *Envir. Sci. Technol.*, **1978**, *12(9)*, 1085.

[14] K.A. Orlandini et al., "Colloidal Behavior of Actinides in an Oligotrophic Lake," *Environ. Sci. Technol.* **1990**, *24*, 706.

[15] W.R. Penrose et al., "Mobility of Plutonium and Americium through a Shallow Aquifer in a Semiarid Region," *Environ. Sci. Technol.* **1990**, *24*, 228.

[16] Cleveland, J.M., Rees, T.F., "Characterization of Plutonium in Ground Water near the Idaho Chemical Processing Plant," *Environ. Sci. Technol.*, **1982**, *16*, 437.

12 cm (and 98-99% of the soil burden occurs in the upper 20 cm of soil)[10] for 903 Pad area soils, (3) efficient movement of Pu through soils requires both pathway, proper speciation, and transport vehicle to be efficient, (4) movement of Pu in-depth in Site soils has proven slow over 3 decades apparently due to natural retardation processes. This thesis is based on the work of Bondietti and Tamura[11], and later, by Litaor et al.[8] In which Pu movement in Site-type soils was found to occur less via subsurface transport than surficial transport. However, some transport has been demonstrated in porous (e.g., sandy) soils and/or when soluble or colloidal species comprise a significant fraction of the material available for transport.

C.5 SUMMARY OF THE OCCURRENCE OF PLUTONIUM IN SOILS

Such studies of Pu in soils combine to provide a working model for the occurrence and characteristics of potential Pu source terms at Site. For purposes of this Plan and based on the previous discussion the following characteristics are postulated or assumed:

1. Plutonium forms a strong association within soils.

2. Plutonium transport is generally slow and aided by the presence of pedogenic factors which increase perviousness of the soil.

3. Environmental deposits of plutonium at Site occur and decrease quickly within a foot of the surface.

4. Plutonium occurs disproportionately attached to smaller particles, perhaps dependent, in part, on the greater availability of adsorption sites per unit weight for smaller versus larger particles.

5. Surficially localized plutonium is potentially available for transport by wind and water erosional forces.

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[10] Litaor, M.I. et al., "Plutonium-239+240 and Americium-241 in Soils East of Rocky Flats, Colorado," *J. Envir. Qual.*, **1994**, *23(6)*,1231.

[11] Bondietti, E.A. and Tamura, T., "Physicochemical Associations of Plutonium and Other Actinides in Soil," in *Transuranic Elements in the Environment*, W.C. Hanson, Ed., DOE/TIC 22800, 1980, pp. 145-164.

tuff material retarded Pu transport which was postulated to occur chiefly by movement of colloidal material.

C.7 OCCURRENCE OF PLUTONIUM IN ROCKY FLATS WATERS

Paine[17] studied plutonium in Site freshwater systems and found rapid transport of plutonium from water phase to pond sediments, with sediments being the major site of plutonium deposition in these systems. The majority of plutonium in water was found associated with the >0.45μm (filterable) particulate. In unfiltered pond-water samples, seston held 30 to 80 percent of the plutonium. Disturbance of the pond sediments during reconstruction in the 1970s resulted in significant resuspension and increases in the surficial sediment Pu activity.

EG&G[18] evaluated seep waters at OU2's 903 Pad and Lip Area for actinide speciation in support of the OU2 Woman Creek Surface Water Interim Measure/Interim Remedial Action Plan. Results indicated the association of plutonium and americium with particulate material in seep water. Filtrates from treatment of seep water by filtration through 0.45μm, 0.2μm, and 0.1μm filters showed significant differences in activity from unfiltered samples. Although only qualitatively determined, a significant portion of the activity in seep water was retained by the 0.45μm filter.

Polzer and Essington[19] evaluated the speciation of Pu in surface water at the Site. Because of the extremely low levels of Pu in the A- and B-series drainage and the corresponding limitations of state-of-the-art analytical methods, only water from Pond C2 could be speciated. Results of duplicate analyses using sequential filtration methods and radiometrics by ultrasensitive, mass-spectrometric methods are reproduced in Table C-1.

Table C-1. Activity vs. Particle Size in Pond C2 Water

Particle Size	Plutonium Activity (%)
> 0.45μm	60-80
<0.45μm - >0.002μm	~ 5
< 0.002μm	17-32

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[17] Paine, D., "Plutonium in Rocky Flats Freshwater Systems", pp. 644-58, in W.C. Hanson, Ed., *Transuranic Elements in the Environment*, DOE/TIC-22800, Technical Information Center/U.S. Department of Energy, April 1980.

[18] EG&G Rocky Flats, "Distribution of Plutonium and Americium in Seep Waters in Operable Unit 2 at the Rocky Flats Plant," prepared by EG&G's Environmental Management Department, August 9, 1991.

[19] Polzer, W.L. and E.H. Essington, "The Physical and Chemical Characterization of Radionuclides in the Surface Waters at Rocky Flats Plant", LA-UR-92-1812 (1992).

Although some 70% of the Pu activity was retained by a 0.45µm absolute filter, recovery and speciation of Pu changed with time and sample preservation. There was little correlation of variation in Pu activity with pH, e_H, conductivity, dissolved oxygen, or alkalinity. Researchers suggested that the variability in Pu activity might be associated with total organic carbon or inorganic constituents such as iron and aluminum.

A complementary but independent work using spiral and tangential flow filtration methods to speciate OU2 seep waters was also conducted by Harnish et al.[20] Their results (Table C-2) differed in detail but indicated 86-99% retention of Pu activity by a 0.45µm filter.

Table C-2. Activity as Function of Particle Size in OU2 Seep Water

Particle-Size Fraction	SW051		SW053	
	Plutonium Activity (pCi/L)	Activity Retained (%)	Plutonium Activity (pCi/L)	Activity Retained (%)
> 5µm	1.16	80	3.28	79
> 0.45µm and <5 µm	0.09	6	0.81	20
< 0.45µm	0.20	14	0.05	1

Together these recent studies validate the general association with, or occurrence of plutonium as particulates in the environment.

Elevated Pu and Am activities were noted in runoff from the OU2 hillside in May 1995. Ad hoc sampling of overland flows by the OU2 Pu in Soils Team returned analytical results showing Pu levels in runoff which varied to 250 pCi/L (Pu) with flows of several pCi/L eventually entering the SID at the base of the hillside. Not unexpectedly, runoff events previously sampled as part of the storm-event monitoring program have also measured storm-water quality reaching several picocuries per liter just upstream of Pond C2.[21] And while releases of detained stormwater from Pond C2 generally meet a 0.05 pCi/L standard, the pond water released from Pond C2 for the period May-June 1995 averaged twice the site-specific standard and briefly reached 0.3 pCi/L (Pu).

[20] Harnish et al., "Particulate, Colloidal, and Dissolved-Phase Associations of Plutonium, Americium, and Uranium in Water Samples from Well 1587, Surface Water SW051, and Surface Water SW053 at the Rocky Flats Plant, Colorado," in press (1995).

[21] Wetherbee, G.A., personal communication, October 1995.

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C.8 SUMMARY FOR PLUTONIUM IN FRESH WATER SYSTEMS

Numerous references describe the occurrence of plutonium and other radionuclides in the aquatic environment.[22,23,24,25] Importantly, these references typically characterize the nature of Pu, Am, and other radionuclides at activities well above 0.1 pCi/L. Environmental conditions which influence the apparent size and chemical characteristics of radiochemical particulates include pH, organic content, dissolved oxygen, and presence of nonvolatile suspended solids. It is unclear to the extent to which these individual factors influence aggregation, or cause complexation or solubilization.

Such studies of Pu in water and sediments of fresh water systems combine to construct a working model for the occurrence and characteristics of Pu in the Site pond system. For purposes of this Plan the following characteristics will be assumed:

1. Plutonium forms a strong association within pond sediments.
2. Particulates larger than 2 μm accumulate in sediments.
3. Substantial portions of total activity (perhaps 95%) deposits are in the sediments.
4. Re-suspension or solubilization of sediment activity (and therefore, migration) is difficult even at elevated pH.
5. The roughly 5% activity remaining in the water phase occurs as a combination of soluble, colloidal or other dispersed micron and sub-micron phases.

This collective assessment holds implications for both the practice of using holding ponds to provide residence time for settling of contaminants, and the nature of the resulting waterborne contaminants. If the 95/5 (weight %) partitioning of radionuclides between the sediment and aqueous phases extends to the sub-pCi/L regime (i.e., sedimentation is independent of Pu activity), then particulates in the sub-2 μm

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[22] Katz, J. J., Seaborg, G. E., Morse, L.R., Eds. *The Chemistry of the Actinide Elements*, 2nd Edition, New York, 1986.

[23] W.C. Hanson, Ed., *Transuranic Elements in the Environment*, DOE/TIC-22800, Technical Information Center/U.S. Department of Energy, April 1980.

[24] *Monitoring of Radioactive Effluents from Nuclear Facilities*, Proceedings of an IAEA Symposium at Portoroz, Yugoslavia in September 1977, STI/PUB/466, International Atomic Energy Agency, Vienna, Austria, 1978.

[25] M.G. White and P.B. Dunaway, Eds., *Transuranic Elements in Natural Environments*, Symposium at Gatlinburg, TN in October 1976, Nevada Applied Energy Group, U.S. ERDA, Las Vegas, NV, NVO-178, June 1977.

regime are implicated as the chief conveyors of "mobile" radionuclides. Analytical methods and treatment approaches should take these characteristics into account.

C.9 LIMITATIONS OF SAMPLING AND RADIOANALYTICAL METHODS

At radiological levels in the sub-pCi/L regime, both sampling and analytical methods can contribute significant uncertainty or variability to measured values. Radiometric measurements also contribute additional variability—random uncertainty—which is associated with the (stochastic) radioactive decay process and background from natural or accumulated (radiological) activity. From a practical standpoint, an additional source of analytical uncertainty arises from nonhomogeneous distribution of particles (and consequently, activity) within the water source.

From the perspective of sampling and contamination, variability of nearly 0.03 pCi is associated with a single (stray) 0.4 μm plutonium oxide (PuO_2) particle (see Table C-3).

Table C-3. Mean PuO2 Particle Diameter vs. Activity

Mean Particle Diameter (μm)	Activity (pCi)/Particle*	Particles to Equal 0.05 pCi
0.1	0.00044	114
0.25	0.0069	7
0.4	0.028	2
0.5	0.055	1
1.0	0.44	< 1

*Calculation assumes a density of 11.5 grams per cubic centimeter (g/cm^3) and a specific activity of 0.073 curies per gram (Ci/g) for PuO_2.

This 0.4 μm particle, if unassociated, could pass the standard 0.45 μm filter, and two such 0.4μm particles in one sample would exceed the 0.05 pCi/L standard. In fact, the presence of only a single 0.4 μm particle could account for the sample-to-sample variability normally observed in routine Site radiochemical data. Variation in mean sample concentrations place an upper limit on sizes of "single" particle contaminants of roughly between 0.25 and 0.4 μm, respectively. Clearly, precautions must be taken to protect against sample contamination both in the field and in the analytical laboratory.

Appendix D: Evaluation of Site-Specific Plutonium and Americium Discharge Standards

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TABLES

D. EVALUATION OF SITE-SPECIFIC STREAM STANDARDS

As mentioned in the Introduction section, the CWQCC site-specific stream standards are 0.05 pCi/L for both Pu and Am. This standard is used only as a water-quality goal that Site water management strives to achieve. The 0.05 pCi/L goals are consistent with DOE As Low as Reasonably Achievable (ALARA) Program goals to maintain public radioactivity exposure to ALARA. There remains the potential and stakeholder flexibility to change these water-quality goals to health-risk based goals which are more consistent with the current national approach in the regulatory community.

It was previously noted that DOE considers the State's site-specific Pu and Am standards as goals that were established to protect the ambient indicated by the data available during the State's 1989 rulemaking. The more recent data represent a more thorough evaluation of the Walnut Creek watershed and suggest that ambient conditions have either changed since 1989 or that the data then available did not accurately reflect water quality conditions. As a result, DOE should consider using the new data to argue for limits on how the stream standards should be used in establishing new permit conditions if it turns out that the State's radionuclide water quality standards may in fact legally form the basis for the Site's discharge permit.

The final level adopted as an applicable standard, whether technical- or risk-based, state-wide, or site-specific ambient, should be protective of human health consistent with policy guiding water quality standards. The state has recently proposed a policy that which charges the WQCC to "establish water quality criteria and standards which will provide a reasonable certainty of protecting the public from adverse risks to their health based upon the best currently available scientific information." This is consistent with the long standing policies of DOE in controlling radionuclides, and should serve as a guide to the final determination.

Figure D-1 through Figure D-4 show there have been very few excursions above 0.05 pCi/L in the A- and B-Series detention ponds except for during extreme storm events (e.g., several inches in 24 hours).

Note that data in Figure D-1 and Figure D-2 for stream gaging stations in North Walnut Creek show higher radionuclide activities in 1994 and 1995 stormwater than in previous years. These data do not indicate increasing contamination in storm runoff. Rather, the data reflect a change in monitoring location and protocol that occurred in 1994.[1]

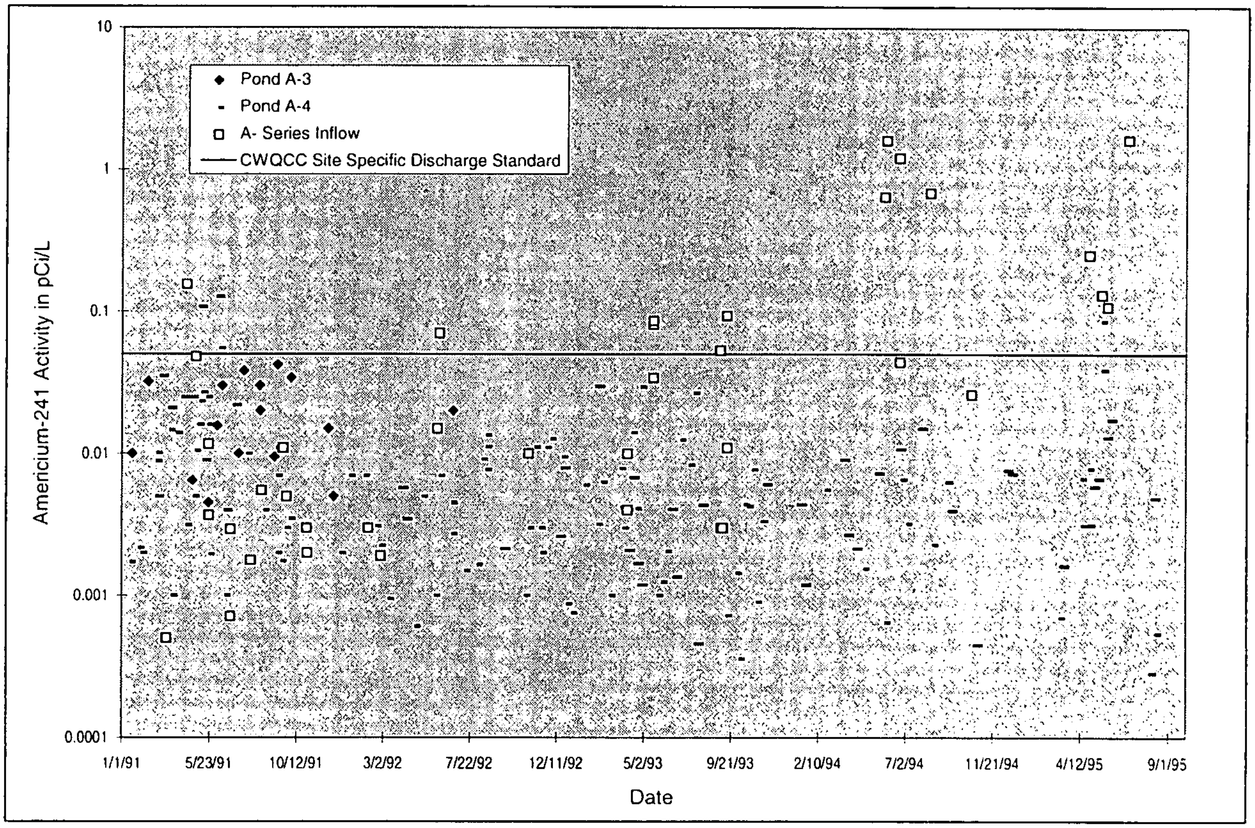

Figure D-1. Variation of Americium Activity with Time for the North Walnut Creek Drainage

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[1] In 1994, storm water monitoring at station GS13 was discontinued and monitoring at station SW093 was reinstated. A wetland lies between SW093 and GS13, and the wetland might be removing contaminated sediments from the water column; thus resulting in very different water quality at each monitoring station. Sampling protocol was also changed in 1994. Prior to 1994, the samples were collected by time pacing the collection and composite of the 15 1-Liter samples. In 1994, the sample compositing was switched to flow pacing. Flow paced composite samples allow for more effective sampling of the first flush of the storm runoff, which is likely to be more contaminated than runoff occurring after the peak discharge is reached. Furthermore, radiochemistry data were obtained from the Site Building 881 Laboratory in 1993, but 1994 radiochemistry data were obtained from off-site subcontracted laboratories. Current radiochemistry data are once again obtained from Building 881 Laboratories. All of these changes between 1993 and 1994/1995 complicate any conclusions about why activities measured in 1994 and 1995 are higher than in previous years in North Walnut Creek.

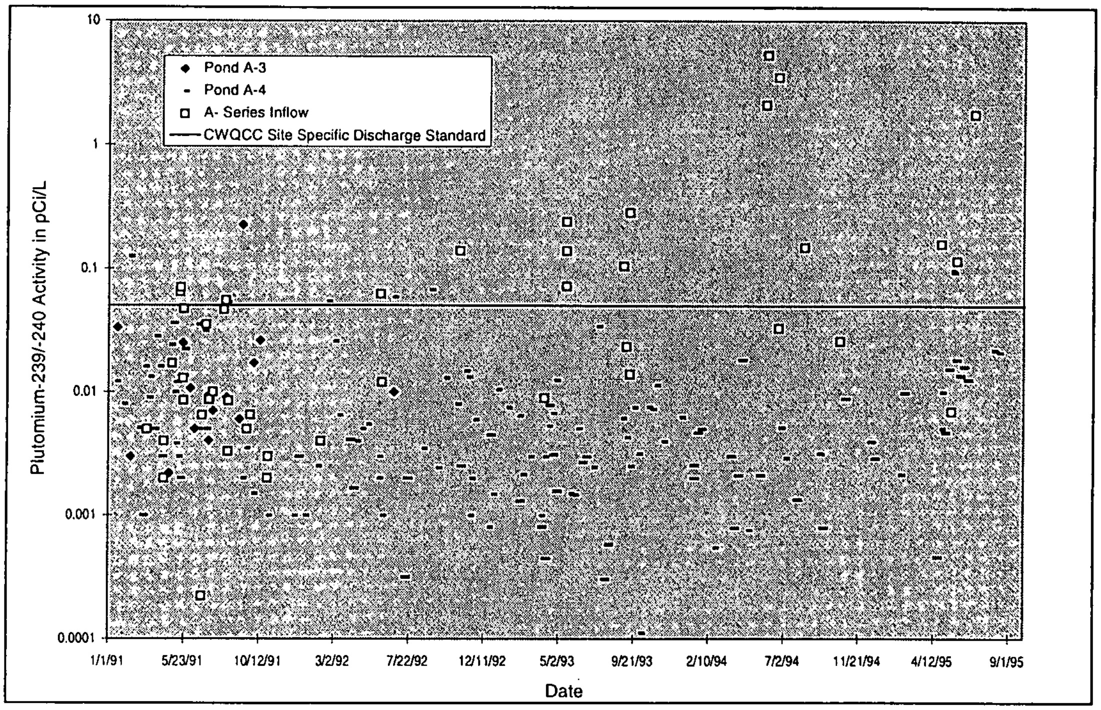

Figure D-2. Variation of Plutonium Activity with Time for the N. Walnut Creek Drainage

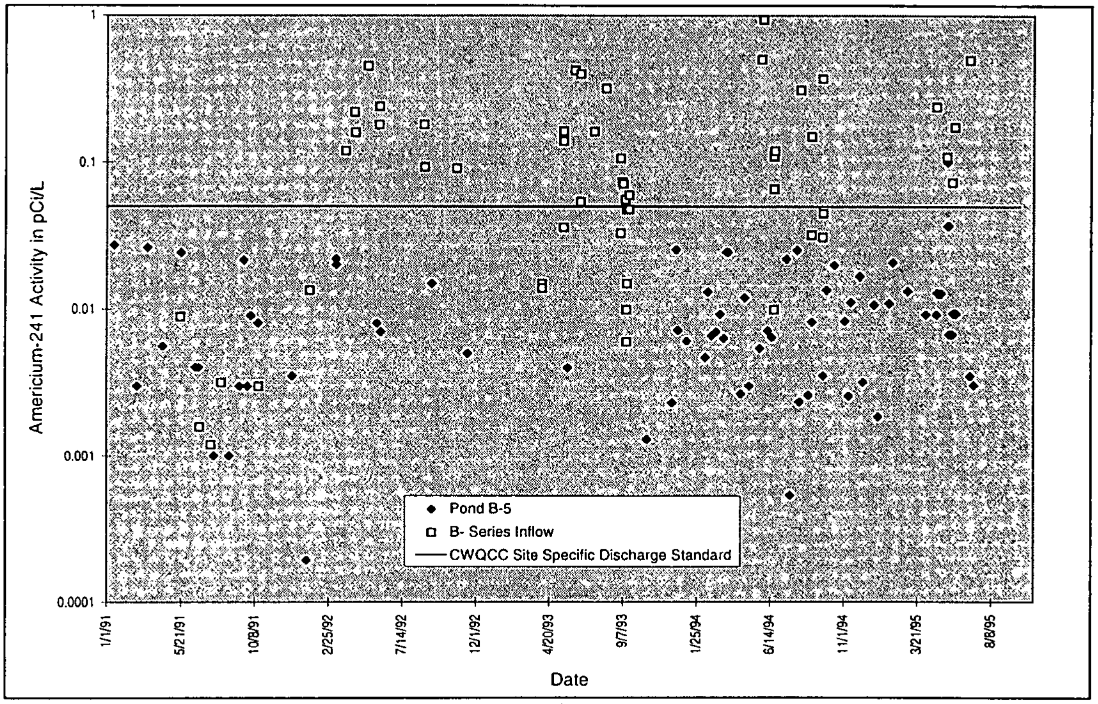

Figure D-3. Variation of Americium Activity with Time for the S. Walnut Creek Drainage

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There are far more occurrences of excursions above the 0.05 pCi/L Pu standard in Pond C-2, with 29% of the Pond C-2 data exceeding 0.05 pCi/L for Pu (Figure D-6). The quality of the Pond C-2 inflows is variable. About half of the Pu activity measurements at SW027 exceeded the 0.05 pCi/L standard.

Figure D-1 through Figure D-6 show that the IA stormwater runoff which is influent to the detention ponds, typically exceeds the standards. However, the discharged pond water is nearly always in attainment of the standards. This demonstrates that the batch-mode operation of the ponds works well as a means to reduce radionuclides in discharges.

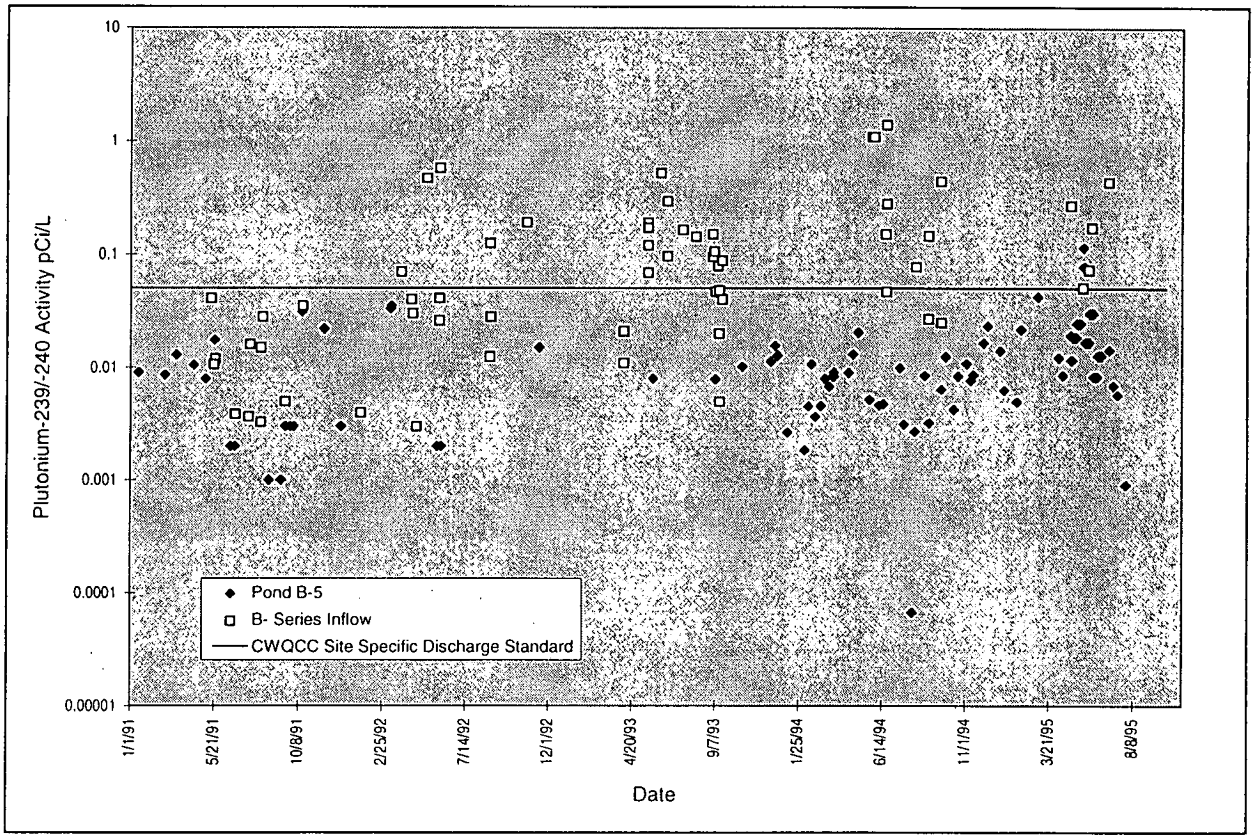

Figure D-4. Variation of Plutonium Activity with Time for the South Walnut Creek Drainage

There is some question about how representative the standards are of Site ambient water-quality, even though it is well known that the Site's standard attainment rate in the detention ponds is excellent. An assessment of the magnitude, frequency, and duration of standard attainment was conducted to evaluate the appropriateness of the standards.

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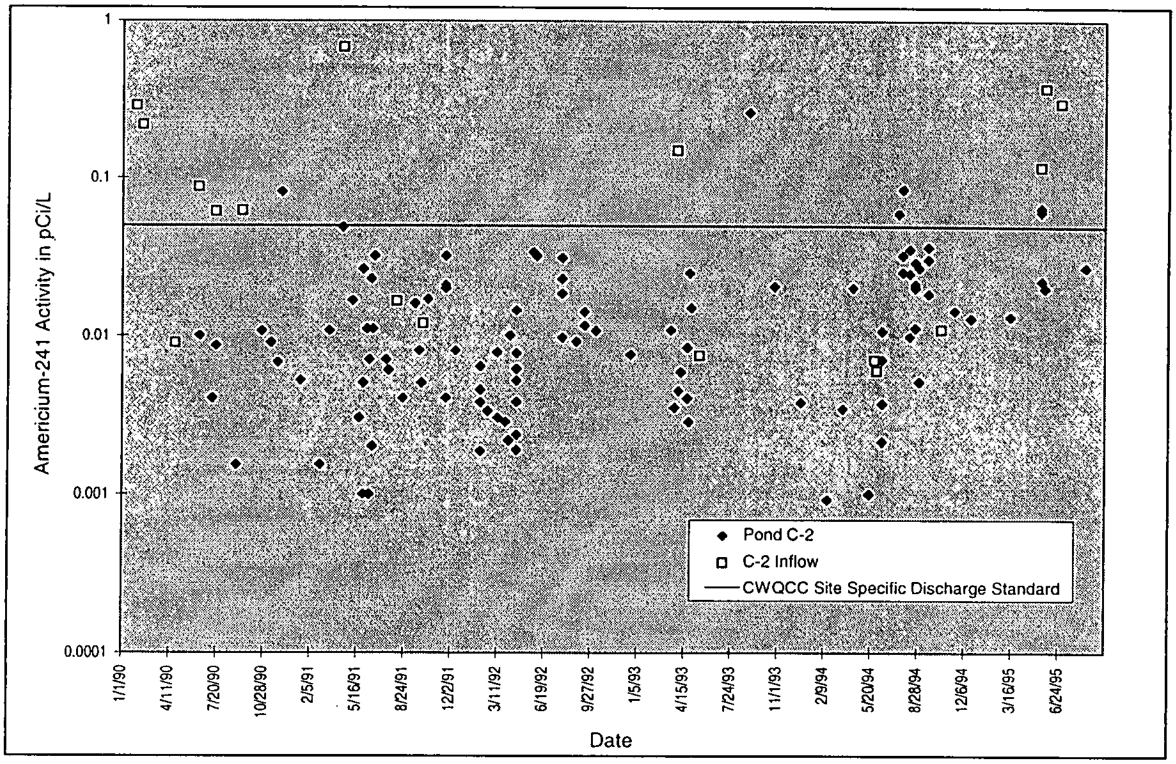

Figure D-5. Variation of Americium Activity with Time for the SID / C-2 Drainage

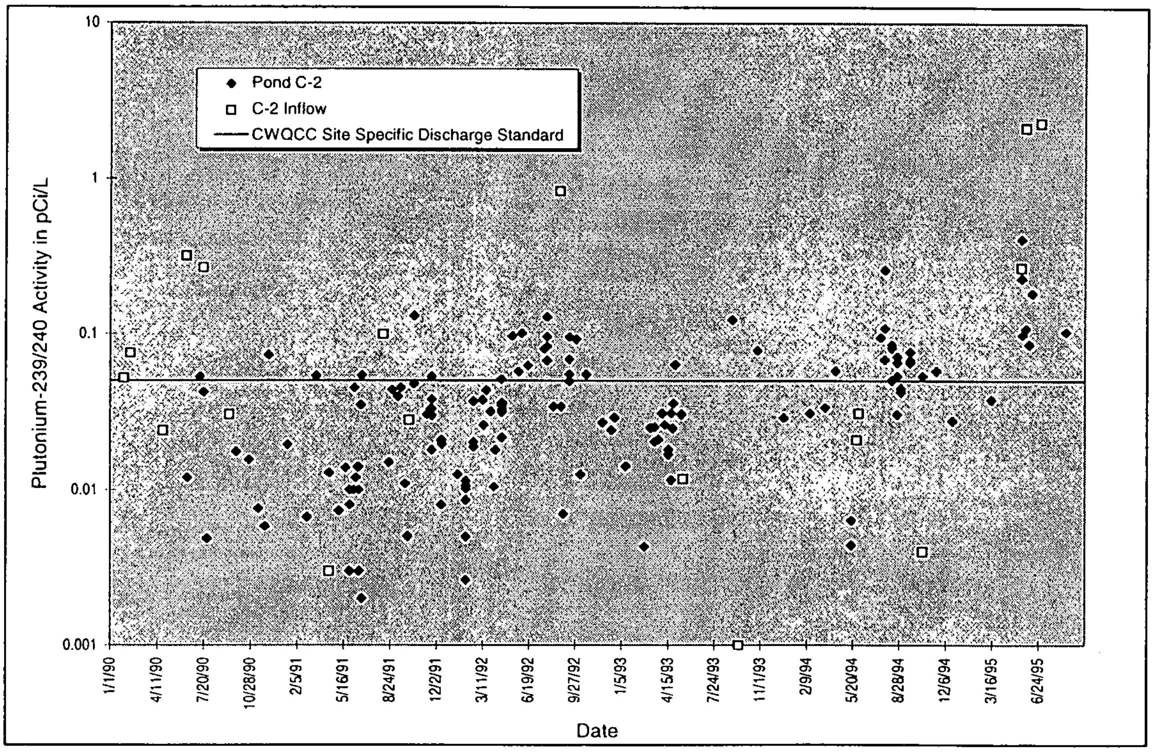

Figure D-6. Variation of Plutonium Activity with Time for the SID / C-2 Drainage

D.1 STANDARD ATTAINMENT

D.1.2 Magnitude of Standard Exceedence

All available historical water-quality data collected from 1991 to date for gaging stations upstream from the detention ponds (inflows) as well as the pond waters themselves were used to examine the magnitude of exceedences above the 0.05 pCi/L Pu and Am stream standards and the 11 pCi/L gross alpha standard. The minimum, mean, and maximum Pu, Am, and gross alpha activities were computed by drainage in two different ways. In the North Walnut Creek drainage, statistics were computed for stations GS13, SW092, and SW093 to analyze standard attainment in stream waters. Then statistics were computed again for GS13, SW092, SW093, Pond A-3, Pond A-4, and Pond A-4 effluent water to analyze standard attainment in the entire North Walnut Creek stream segment. In the South Walnut Creek drainage, statistics were computed for stations GS10 and SW023 to analyze standard attainment in stream waters. Then statistics were computed again for GS10, SW023, GS09, Pond B-5, and Pond B-5 effluent to analyze standard attainment in the entire South Walnut Creek stream segment. In the SID/Pond C-2 system, statistics were computed for station SW027 to analyze standard attainment in SID inflows to Pond C-2. Then statistics were computed again for station SW027 and Pond C-2 together to analyze standard attainment in the entire SID/Pond C-2 system.

The results of the standard magnitude attainment analysis are shown in Table D-1. The results show that the current CWQCC standards of 0.05 pCi/L Pu and Am are not representative of all hydrologic conditions at the Site, and thus not representative of ambient conditions. Therefore, it appears that the CWQCC standards might not be applicable to Site conditions.

In North Walnut Creek, the computed average inflow activity is 0.30 pCi/L for Pu; 0.17 pCi/L for Am; and 11.6 pCi/L for gross alpha. The computed average stream segment activity is 0.07 pCi/L for Pu; 0.04 pCi/L for Am; and 2.5 pCi/L for gross alpha (See Table D-1).

In South Walnut Creek, the computed average inflow activity is 0.19 pCi/L for Pu; 0.16 pCi/L for Am; and 10.8 pCi/L for gross alpha. The computed average stream segment activity is 0.08 pCi/L for Pu; 0.07 pCi/L for Am; and 4.6 pCi/L for gross alpha (See Table D-1).

At the mouth of the SID (SW027) the computed average inflow activity is 0.32 pCi/L for Pu; 0.12 pCi/L for Am; and 4.6 pCi/L for gross alpha. The computed average stream segment activity is 0.08 pCi/L for Pu; 0.03 pCi/L for Am; and 3.0 pCi/L for gross alpha (See Table D-1). Note that the population of SW027 isotope-specific radionuclide data has only 17 data points.

Table D-1. Magnitude of Potential Exceedence of Selected CWQCC Site-Specific Radiochemical Discharge Standards

North Walnut Creek Drainage Summary Statistics for 1991-1995 Water-Quality Data

[Statistics for **Inflows** are calculated from all available data for stations SW092, SW093, and GS13]

[Statistics for **Stream Segment** are calculated from all available data for stations SW092, SW093, GS13, Pond A-3, Pond A-4, and Pond A-4 Effluent]

Pu-239, -240 Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	0.300	0.022	0.000	0.005	5.300	0.180
Stream Seg.	0.070	0.038	0.000	0.019	5.300	0.180

Am Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	0.171	0.085	0.000	0.008	1.620	0.221
Stream Seg.	0.042	0.067	0.000	0.082	1.620	0.221

Gross Alpha Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	11.635	3.046	0.000	1.100	110.000	15.000
Stream Seg.	2.516	1.140	0.000	1.083	110.000	15.000

South Walnut Creek Drainage Summary Statistics for 1991-1995 Water-Quality Data

[Statistics for **Inflows** are calculated from all available data for stations SW023 and GS10]

[Statistics for **Stream Segment** are calculated from all available data for stations SW023, GS10, Pond B-5, and Pond B-5 Effluent]

Pu-239, -240 Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	0.189	0.024	0.003	0.015	1.400	0.041
Stream Seg.	0.077	0.015	0.000	0.012	1.400	0.041

Am Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	0.156	0.036	0.000	0.024	0.940	0.200
Stream Seg.	0.065	0.020	0.000	0.015	0.940	0.200

Gross Alpha Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	10.818	2.416	1.500	1.800	86.000	15.000
Stream Seg.	4.560	1.457	0.000	0.000	86.000	15.000

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Table D-1. Magnitude of Potential Exceedence of Selected CWQCC Site-Specific Radiochemical Discharge Standards (continued)

SID / C-2 Drainage Summary Statistics for 1991-1995 Water-Quality Data
[Statistics for **Inflows** are calculated from all available data for stations SW027]
[Statistics for **Stream Segment** are calculated from all available data for stations SW027, Pond C-2, and Pond C-2 Effluent]

Pu-239, -240 Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	0.325	0.028	0.000	0.018	2.289	0.090
Stream Seg.	0.079	NA	0.000	0.024	2.289	0.090

Am Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	0.121	0.066	0.000	0.215	0.680	0.290
Stream Seg.	0.030	0.023	0.000	0.043	0.680	0.290

Gross Alpha Activity [pCi/L]

	Average	Average Error	Min	Associated Error	Max	Associated Error
Inflows	4.582	2.027	0.000	1.550	30.980	9.188
Stream Seg.	3.011	1.353	0.000	0.880	30.980	9.188

D.1.3 Frequency of Standard Attainment and Exceedence

The frequency, or number of times, that the standard will be exceeded was evaluated by analyzing Site stream flow data in conjuction with precipitation and water-quality data from gaging stations GS10 (S. Walnut Creek), SW093, and GS13 (N. Walnut Creek) for Water Years 1993 - 1995. This analysis was done separately for each drainage basin. Note that a lack of accurate flow information and a very limited number of water-quality samples with accompanying flow measurements prevented meaningful evaluation of the frequency of standard attainment and exceedence for the SID/Pond C-2 system.

D.1.3.1 South Walnut Creek

At GS10, there is an acceptable correlation between flow and Pu, Am, and gross alpha activities; yielding correlation coefficients of 0.73, 0.74, and 0.92 respectively (Figure D-7). Selected analytical data were used to generate these regression models, and the assumptions used to select these data are detailed in the Attenuation Modeling section of this report. The regression equations were then used to estimate the smallest flow that produces activities exceeding the CWQCC standards. When flow record for GS10 was unavailable for certain periods, a flow value was empirically generated from a relationship at GS10 between total precipitation and the corresponding maximum observed stormwater flow. Finally, the daily discharge record was evaluated to determine the number of days that this minimum flow was exceeded; which equals the number of days that the standards might be exceeded. Results of this analysis are shown in Table D-2.

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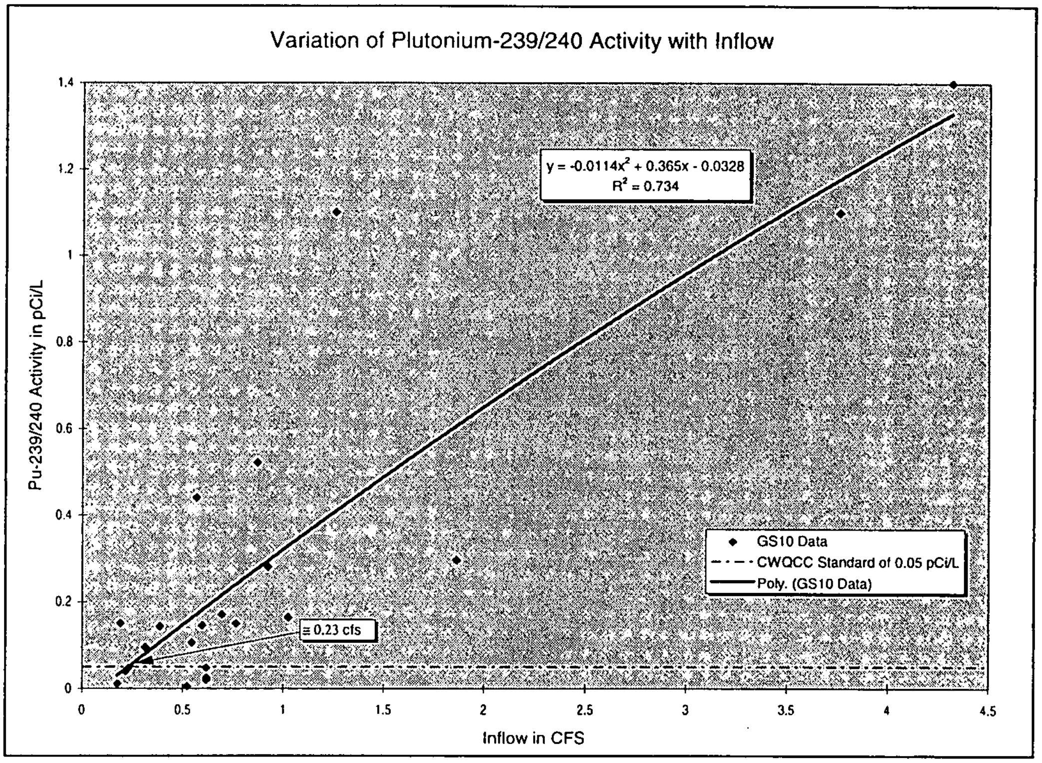

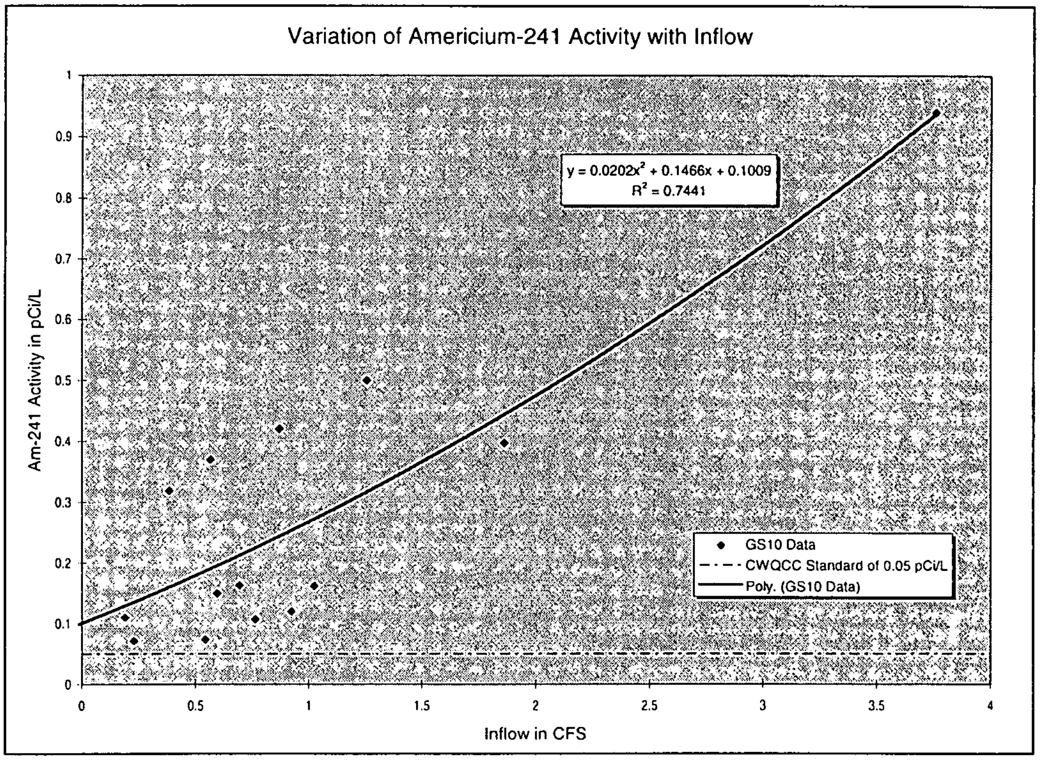

Figure D-7. Variation of Pu, Am, and Gross Alpha Activity with Inflow for the South Walnut Creek Drainage.

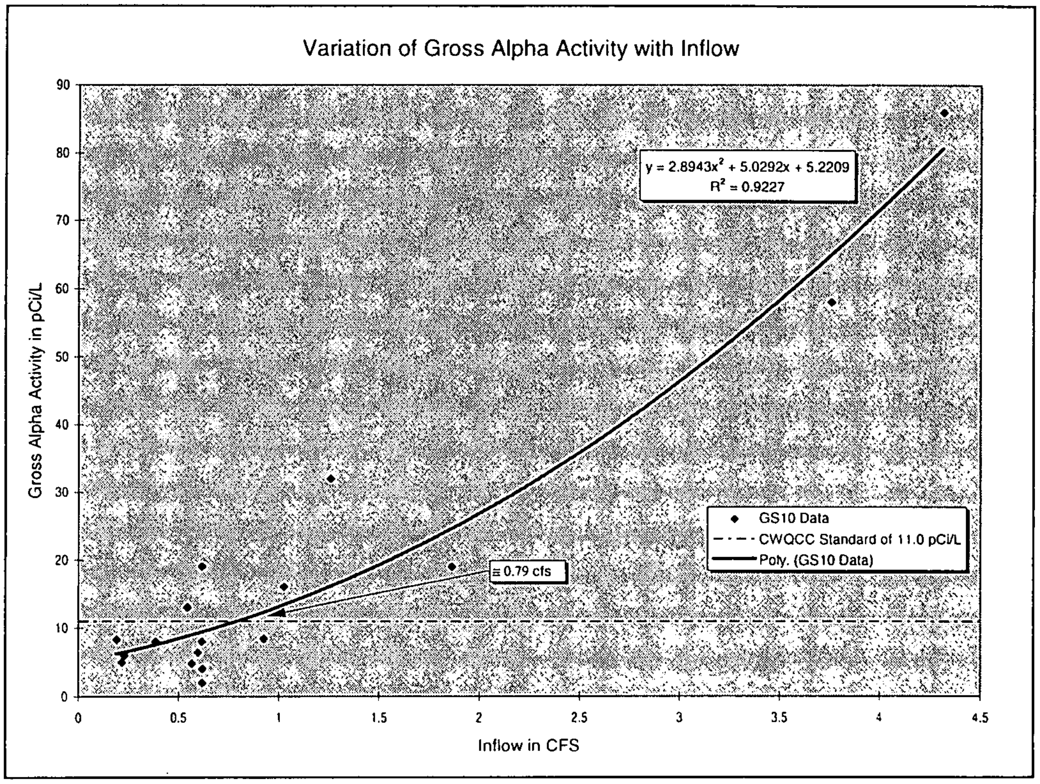

Figure D-7. Variation of Pu, Am, and Gross Alpha Activity with Inflow for the South Walnut Creek Drainage.(continued)

Table D-2. South Walnut Creek Frequency of Potential CWQCC Standard Exceedence

[Standards, in picocuries/liter: 0.05 - Pu, Am; 11.0 - gross alpha]
Italicized values contain flows estimated from precipitation data

Estimated number of days with an exceedence

Month	Pu	Am	Gross Alpha
October	6.83	31.00	2.83
November	9.00	30.00	2.50
December	0.50	31.00	0.00
January	*1.00*	31.00	*0.00*
February	*5.33*	28.00	*0.00*
March	9.83	31.00	3.67
April	15.67	30.00	10.00
May	15.50	31.00	7.67
June	11.67	30.00	6.00
July	4.33	31.00	0.67
August	5.00	31.00	2.00
September	5.00	30.00	3.50
Totals:	**90**	**365**	**39**

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D.1.3.2 North Walnut Creek

Because there are no definitive correlations between flow and radiochemical parameters at the North Walnut Creek gaging stations GS13 and SW093, a different approach was used to determine standard exceedence frequency in North Walnut Creek (Figure D-8). Instead of using statistical correlations, the data were evaluated to empirically find the smallest stormwater radionuclide activities that were measured to be above the CWQCC standards. The flows which produced these minimum activities exceeding the standards were then recorded as minimum cutoff flows for an exceedence. When flow record for GS13 and SW093 was unavailable for certain periods, a flow value was empirically generated from a relationship at these gages between total precipitation depth and the corresponding maximum observed stormwater flow. Then the flow record was evaluated to compute the number of days per year that these cutoff flow rates were exceeded. Results of this analysis are shown in Table D-3.

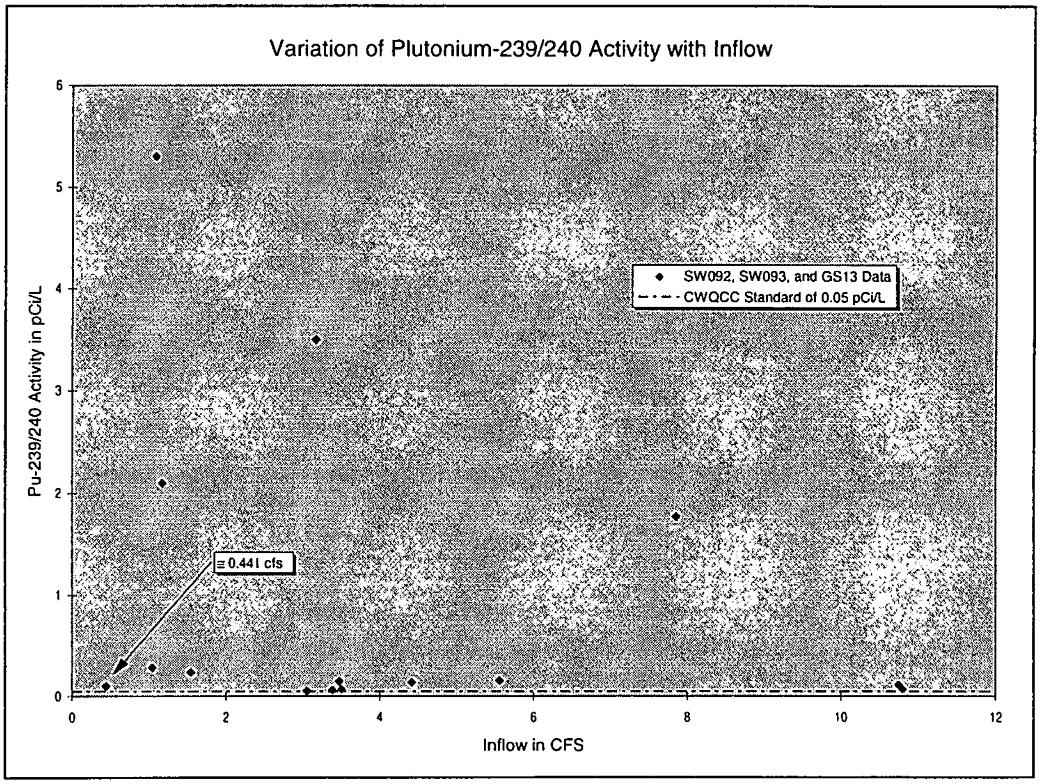
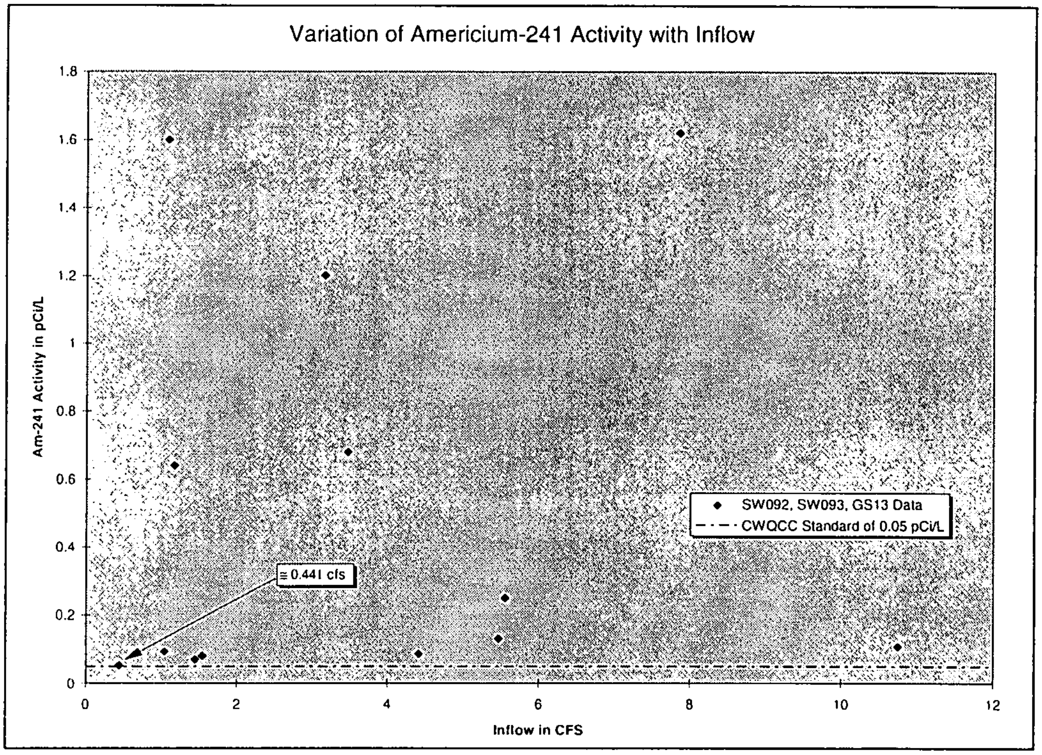


Figure D-8. Variation of Pu, Am, and Gross Alpha Activity with Inflow for the North Walnut Creek Drainage



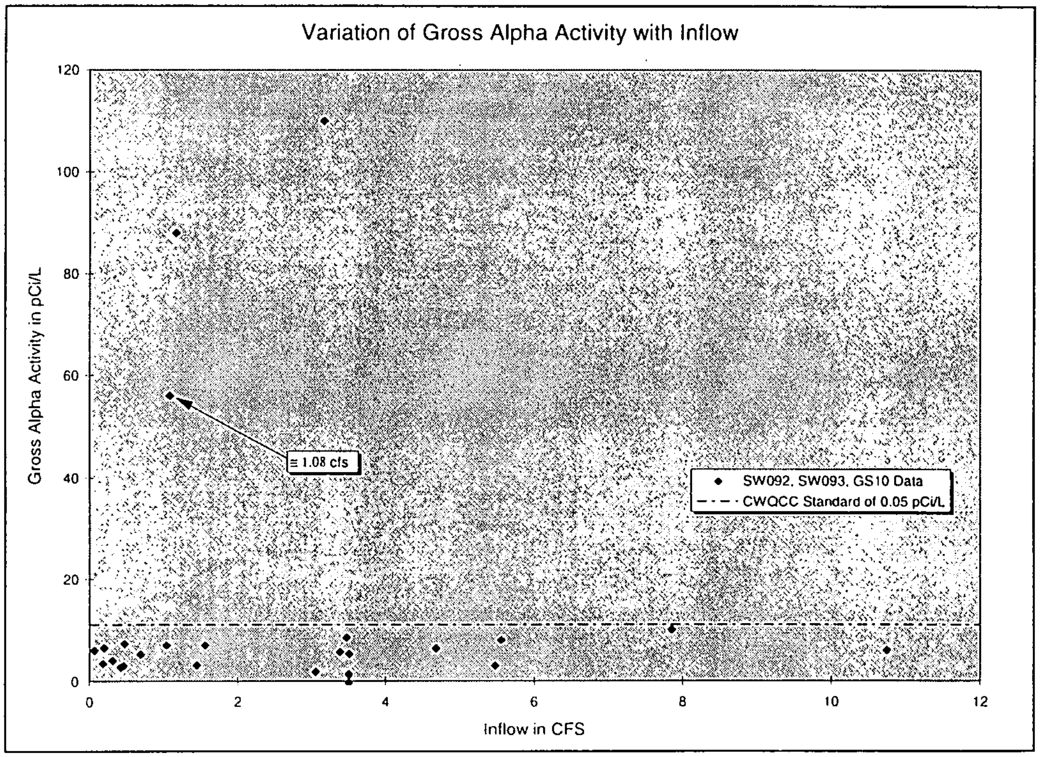


Figure D-8. Variation of Pu, Am, and Gross Alpha Activity with Inflow for the North Walnut Creek Drainage (continued)

Table D-3. North Walnut Creek Frequency of Potential CWQCC Standard Exceedence
[Standards, in picocuries/liter: 0.05 - Pu, Am; 11.0 - gross alpha]
Italicized values contain flows estimated from precipitation data

Estimated number of days with an exceedence

Month	Pu	Am	Gross Alpha
October	3.00	3.00	2.00
November	6.50	6.50	1.00
December	*0.50*	*0.50*	*0.00*
January	*0.00*	*0.00*	*0.00*
February	*2.67*	*2.66*	*0.33*
March	*6.00*	*6.00*	*2.67*
April	15.50	15.50	9.67
May	13.83	13.83	8.50
June	9.17	9.17	6.00
July	1.33	1.33	1.00
August	2.67	2.67	1.00
September	4.50	4.50	2.00
Totals:	**66**	**66**	**34**

D.1.4 Duration of Standard Exceedence

Duration, or length of time, of standard exceedence was computed using the same methodology described in the Frequency of Standard Attainment and Exceedence section to arrive at the minimum flow that produces a standard exceedence. This flow is considered a threshold for standard attainment. The time intervals where the threshold flows were exceeded, were summed on a monthly basis for Water Year 1993-95 flow data to arrive at a monthly duration of potential standard exceedence. Results of this analysis are shown in Table D-4. Note that a lack of accurate flow information and a very limited number of water-quality samples with accompanying flow measurements prevented meaningful evaluation of the duration of standard attainment and exceedence for the SID/Pond C-2 system.

Standard exceedence duration values for months with missing flow record were estimated by assuming that the ratio of calculated frequency of standard exceedence to calculated duration of standard exceedence is constant for that month. This proportional relationship was extrapolated to time periods with missing hydrologic data using the estimated frequencies given in the previous section. The months with estimations are shown in italics in Table D-4.

Table D-4. Average Duration of Potential Standard Attainment and Exceedence by Drainage Area

North Walnut Creek Duration of Potential CWQCC Standard Exceedence
[Standards, in picocuries/liter: 0.05 - Pu, Am; 11.0 - gross alpha]

Duration in Hours

Month	Pu	Am	Gross Alpha
October	20.71	20.71	8.88
November	23.08	23.08	0.08
December	*0.08*	*0.08*	*0.00*
January	*0.00*	*0.00*	*0.00*
February	*6.68*	*6.68*	*1.97*
March	*34.14*	*34.14*	*15.98*
April	221.93	221.93	87.19
May	197.54	197.54	83.71
June	94.97	94.97	32.67
July	2.58	2.58	0.67
August	3.42	3.42	1.75
September	15.29	15.29	4.33
Totals:	**620**	**620**	**237**

South Walnut Creek Duration of Potential CWQCC Standard Exceedence
[Standards, in picocuries/liter: 0.05 - Pu, Am; 11.0 - gross alpha]

Duration in Hours

Month	Pu	Am	Gross Alpha
October	26.25	744.00	10.21
November	54.17	720.00	4.96
December	0.38	744.00	0.00
January	*2.63*	744.00	*0.00*
February	*13.37*	672.00	*0.00*
March	43.38	744.00	9.54
April	213.08	720.00	73.06
May	182.78	744.00	39.06
June	135.22	720.00	22.25
July	6.53	744.00	1.00
August	6.67	744.00	2.25
September	22.46	720.00	6.13
Totals:	**707**	**8760**	**168**

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D.2 DISCUSSION OF STANDARD ATTAINMENT

The results shown in Table D-1 through Table D-4 indicate that the expected average magnitude of potential instream standard exceedence in North Walnut Creek is approximately 0.25 pCi/L for Pu; 0.12 pCi/L for Am; and 0.6 pCi/L for gross alpha activity. The results also indicate that the expected average magnitude of potential instream standard exceedence in South Walnut Creek is approximately 0.14 pCi/L for Pu and 0.11 pCi/L for Am.

The Pu and Am standards potentially will be exceeded on 66 days per year for North Walnut Creek. The Pu standard potentially will be exceeded 96 days per year and the Am standard potentially will be exceeded 365 days per year at GS10 in South Walnut Creek. The average duration of the Pu and Am standard exceedence in North Walnut Creek is 620 hours per year. The average duration of the Pu standard exceedence is 707 hours per year and the Am standard potentially will be exceeded 8760 hours per year.

In other words, the standards for Pu and Am are achieved 93% of the time on an annual basis in North Walnut Creek upstream from the A-series ponds. The standard for Pu is achieved 92% of the time on an annual basis in South Walnut Creek upstream from the B-series ponds. However, the Am standard is estimated to never be achieved (0% of the time) in South Walnut Creek upstream from the B-series ponds. Gross alpha activity standards are achieved 97% of the time on an annual basis for North Walnut Creek and 98% of the time on an annual basis for South Walnut Creek.

It was previously noted that the site-specific Pu and Am standards were goals based on ambient conditions at the time the standards were proposed in 1989. These more recent data represent a more thorough evaluation of the Walnut Creek watershed and suggest that ambient conditions have either changed since 1989 or that the data used in those proceedings did not accurately reflect water quality conditions. As a result, the standard setting process may have to be repeated once clear lines of authority have been agreed to by all parties.

As an alternative to the site specific goal, the statewide standard for plutonium, 15 pCi/l, has been suggested as an enforceable limitation (either by agreement or as a permit condition) to demonstrate "standard attainment". This standard has been used as a clean-up level for various environmental restoration activities at the Site, and is in agreement with levels regulated under DOE orders and NRC rules. Thus, the state-wide standard can be defended, and should be used, as a technical-based water quality standard as compared to ambient standards, which have no technical basis, and are generally used in circumstances where water quality does not meet standards established by applicable use classifications. Because Pu and Am are not regulated under the CWA, there are no use protective standards, which would be technically defensible, established for these parameters. Consequently, the most appropriate measure of standard attainment is the state-wide standard, which is also a clean-up standard.

The final level adopted as an applicable standard, whether technical-based, state-wide, or ambient, should be protective of human health consistent with policy guiding water quality standards. The state has recently proposed such a policy which charges the WQCC to "establish water quality criteria and standards which will provide a reasonable certainty of protecting the public from adverse risks to their health based upon the best currently available scientific information." This is consistent with the long standing policies of DOE in controlling radionuclides, and should serve as a guide to the final determination.

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"POND OPERATIONS PLAN: Revision 2"

September 1996

Plate 1:

Radionuclide Related IHSS Locations, Drainage Pathways and Potential Plutonium Surface Areas

Map ID: PSSL

December 22, 1995

CERCLA Administrative Record Document, I101 - A - 000257

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"POND OPERATIONS PLAN: Revision 2"

September 1996

Plate 2a:

Areal Distribution of Pu-239, 240 Activity in Industrial Area Drainage Sediments

Map ID: new-trench

December 06, 1995

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"POND OPERATIONS PLAN: Revision 2"

September 1996

Plate 2b:

Areal Distribution of Am-241 Activity in Industrial Area Drainage Sediments

Map ID: new-trench

December 06, 1995

CERCLA Administrative Record Document, I101 - A - 000257

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September 1996

Plate 3:

Integrated OU HPGe Results for Am-241

Map ID: hpge-am

October 18, 1995

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September 1996

Plate 4a:

Areal Distribution of Pu-239, 240 Activity in Surface Soils

Map ID: pu-mchugh

December 19 1995

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"POND OPERATIONS PLAN: Revision 2"

September 1996

Plate 4b:

Areal Distribution of Am-241 Activity in Surface Soils

Map ID: pu-mchugh

December 19 1995

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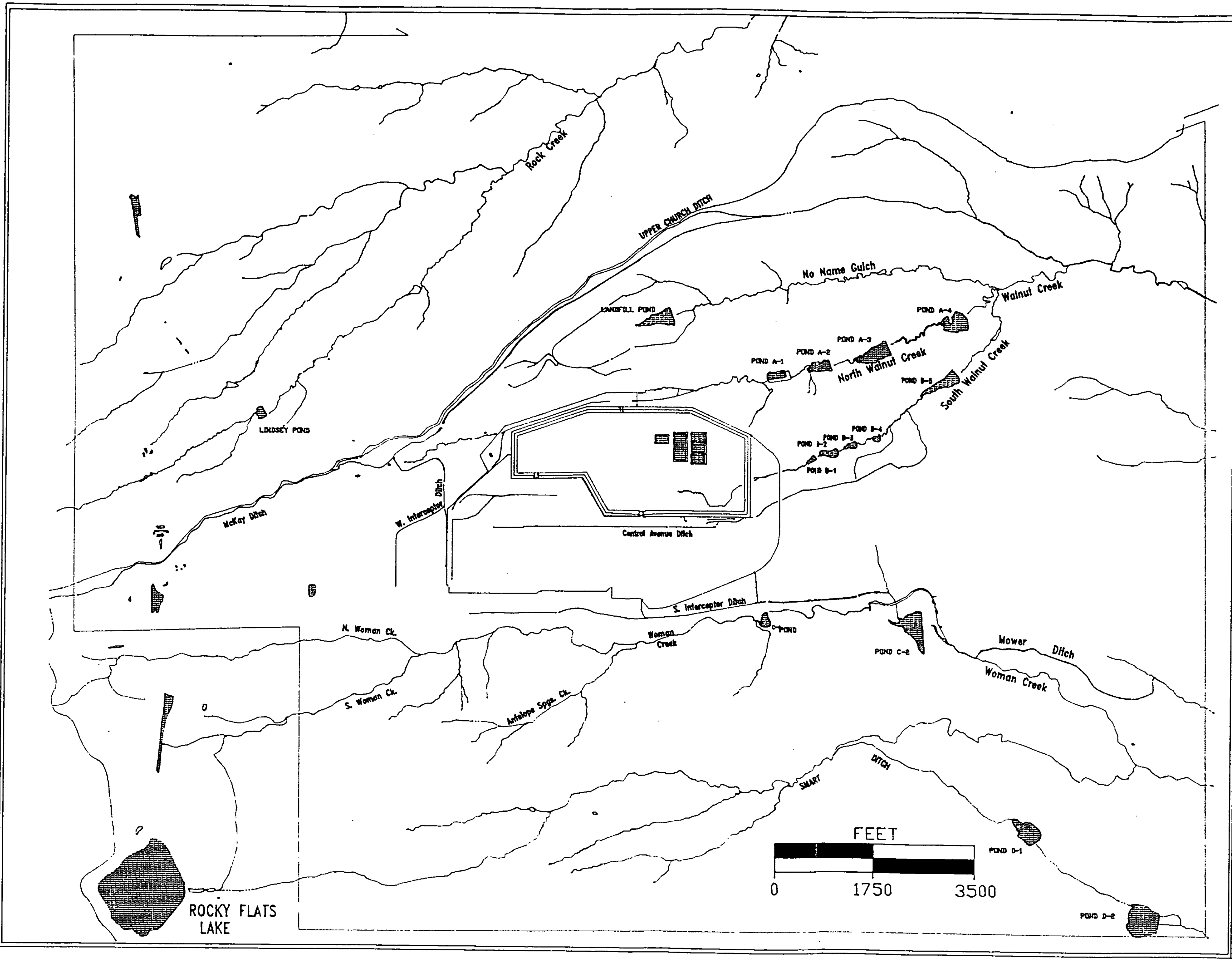
246/246



LEGEND

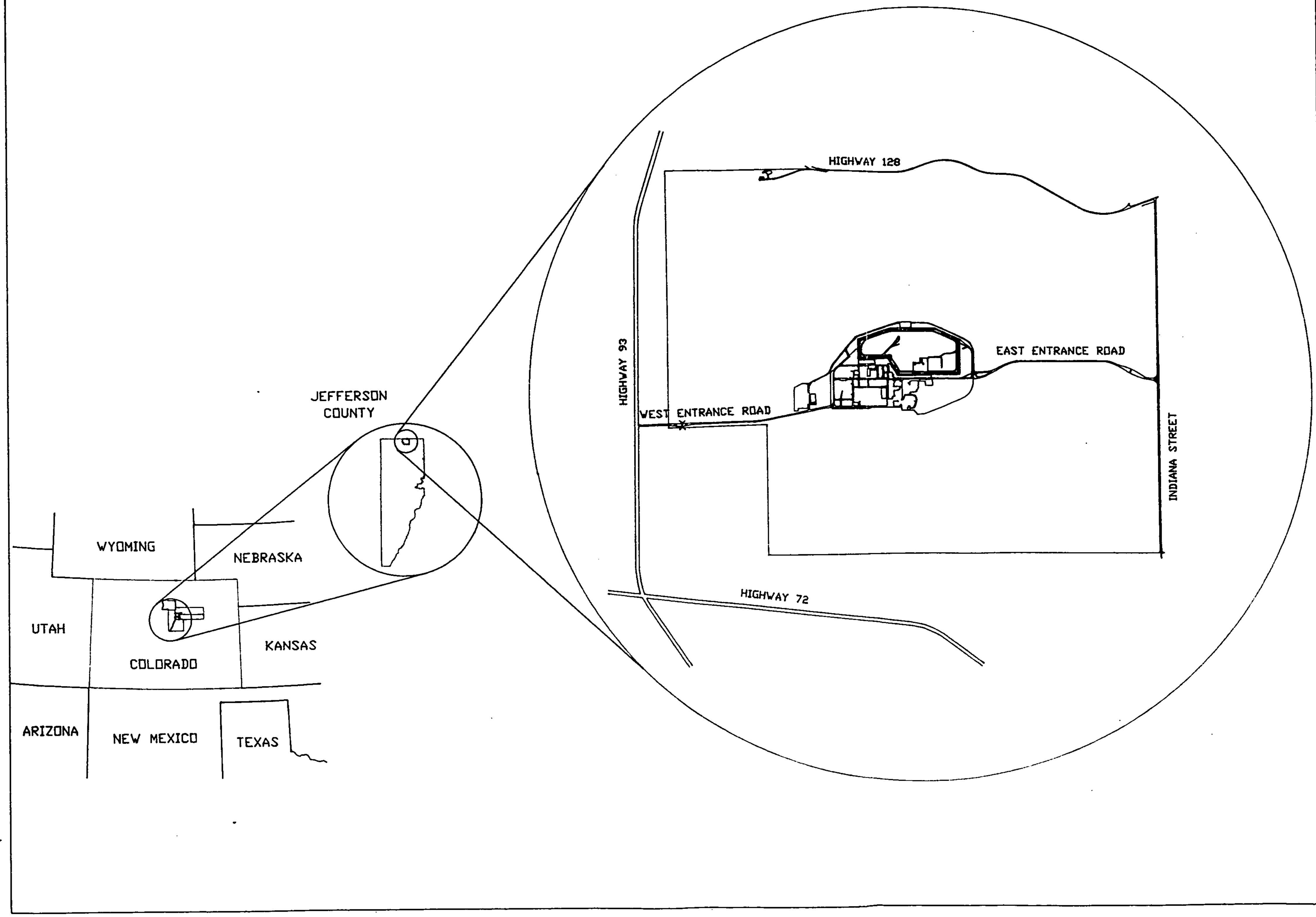
Streams, Ditches, Drainage Features

Security Fences

Figure 1-1

Site Drainage Features and Detention Ponds

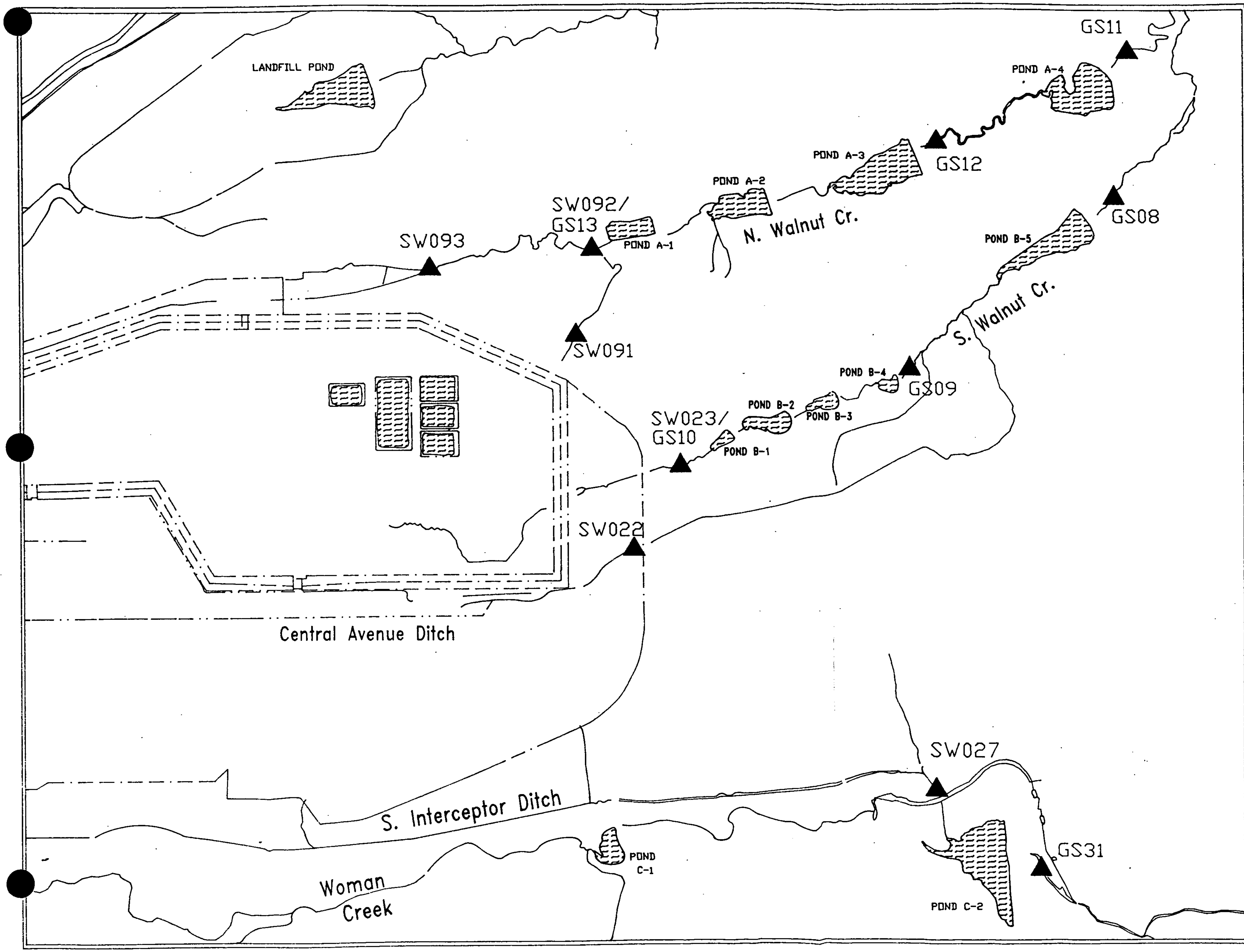
6



Pond Operations Plan
Technical Appendix

Figure 2-1
Location of Rocky Flats Environmental Technology Site

45



LEGEND

Gaging and Sampling Station

Streams, Ditches, Drainage Features

Security Fences

Figure 2-3

Pond Operations Plan
Technical Appendix

Study Area

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